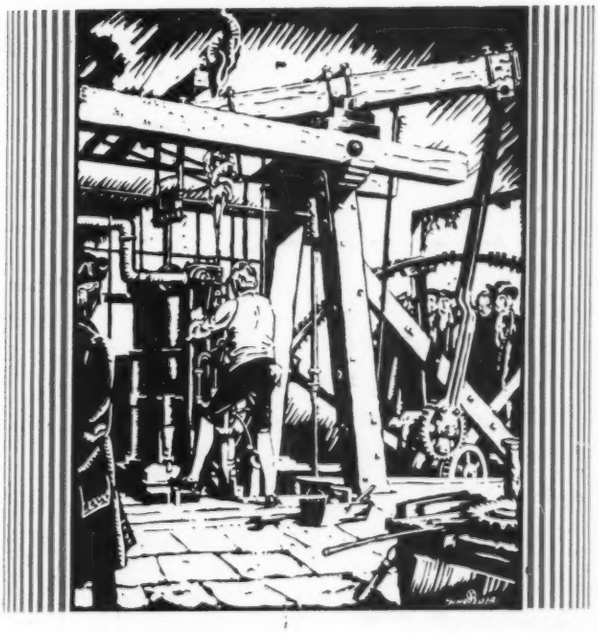
MAY 1934

# MACHINE DESIGN



AS IT AFFECTS

ENGINEERING—PRODUCTION—SALES

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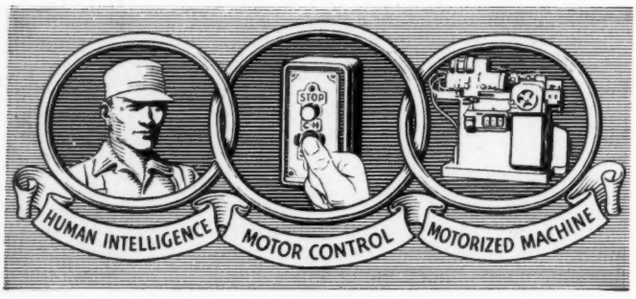


UNTIL the long finger of radio swept the seas, lives and cargo out of port were apart from the living world. But radio . . . communication . . . brought to the ocean that speed and security which control through rapid and accurate communication alone makes possible.

In Industry Motor Control is the means of *communication* . . . the one link between human intelligence and motorized machines. It is far more important than either its size or cost might suggest.

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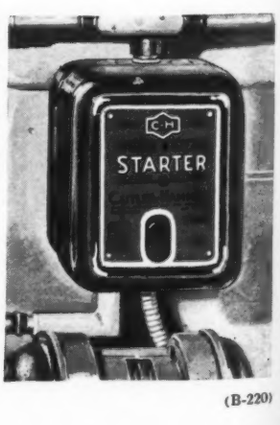
*The designing and building of Motor Control is a separate and distinct division of electrical engineering. The place to go for consultation and advice on Motor Control problems is to a control specialist. Cutler-Hammer indisputably qualifies as such a specialist. Your problems will be welcomed here. A letterhead request brings the C-H Catalog.*




(B-220)

NRA

**CUTLER HAMMER**

***The Control Equipment Good Electric Motors Deserve***

# MACHINE DESIGN

FRANKLIN H. JOHNSON
*Publisher*

VOLUME VI MAY, 1934 NUMBER 5

## CONTENTS

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Machine Design is published on the tenth of each month. Subscription rates: United States and possessions, Cuba and Mexico, two years $5; one year $3. Single copies, 35 cents. Canada, one year $4.80, including duty. Great Britain and other European countries, two years, £1.13.6; one year £1.0.0. 


## THE PRODUCT

New Departures, made in the world's largest ball bearing factory, will fulfill practically every service requirement. The diversified line provides for all conditions of load and mounting encountered in the modern machine. »»» The new 128-page Catalog contains full listing of all new types and sizes, new list prices and important mounting directions. Mailed upon request. Ask for Booklet S. Ninth edition.

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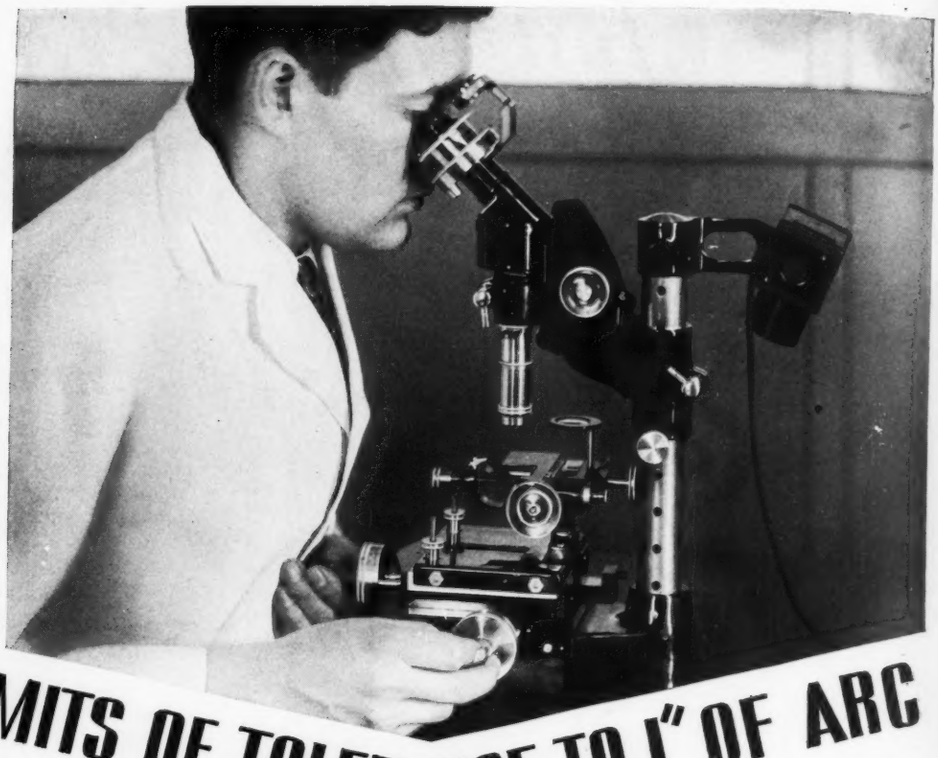
# ITEMIZED INDEX

*Classified for Convenience when Studying Specific Design Problems*



*Key: Edit, Editorial Pages; Adv, Advertising Pages; R, Right hand column; L, Left hand column*



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ORIGINALLY this Dimensioning Microscope was designed for use by the toolmaker. However, the development of accessories and discovery of new uses has greatly increased the scope of the instrument. Now it is being used by mechanical engineers and by mechanics in general for the inspection and measurement of any small, precise mechanical parts.

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**THE new General Electric CR1061 motor switch meets the demand for a small, but dependable, switch which will provide positive protection for fractional-horsepower motors. Note these outstanding features:**

**1. Trip-free—under injurious overload conditions, the switch cannot be restarted until it has cooled to safe operating temperature.**

**2. Unusually large, pure-silver contacts—an assurance of long life and trouble-free service.**

**3. Switch has a snap action—prevents slow opening or closing and burning of contacts.**

**4. Housed in a strong steel case with aluminum cover. It is also available without enclosure, ready to build into your machine.**

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**Would you like additional information? If so, write for a copy of our new descriptive bulletin, GEA-1761. Address the nearest G-E office, or General Electric, Dept. 6C-201, Schenectady, N. Y.**

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080-9

# NICKEL

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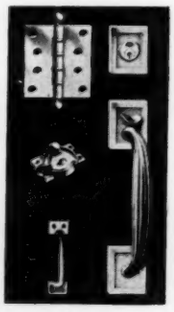
Again the answer was Nickel... Nickel in the form of Solid Nickel Silver.

Solid Nickel Silver is made by alloying from 12 to 25 per cent of Nickel with either brass or bronze. The Nickel content imparts the desired white color and a dense-grained structure which gives lifetime wearing qualities.

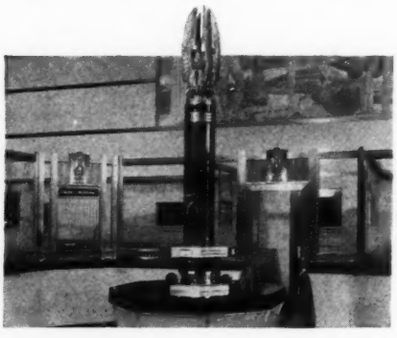
Much of the white metal that is used in modern ornamentation is long-enduring Solid Nickel Silver. Today you see it everywhere... everywhere that metal work must combine beauty of color and low cost maintenance.



In almost any up-to-date building you find doorways, grille work, trim, hardware... metal fixtures of every kind . . . glowing with its soft warm highlights.

Serving many of the same purposes, you also see silvery surfaces of another white alloy. This material is Monel Metal... a natural alloy of Nickel and copper.

These alloys of high Nickel content offer decorative opportunities that are indispensable to the modern architect and builder, but there are dozens of other alloys containing Nickel that are also indispensable in *every field* where man uses metals.



The alloys containing Nickel embrace a variety of compositions, each carefully determined as a result of laboratory and service tests. They offer a wide range of improved properties... properties that assure increased resistance to heat, stress, fatigue, erosion, corrosion, abrasion and wear.

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The nearest Linde District Office will be glad to help you capitalize on this experience and to illustrate with actual examples from your own industry how Linde Process Service might help you.

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# CALENDAR OF MEETINGS AND EXPOSITIONS

**May 14-16—**

**National Petroleum Meeting.**

Sponsored by the Petroleum division of the American Society of Mechanical Engineers this meeting will be held in Tulsa, Okla., in connection with the International Petroleum Exposition. Technical papers will include: "Air-Gas Compressor Characteristics," by J. P. Klep; "Gas-Electric Prime Movers for Rotary Drilling," by D. M. McCarger; "Oil Field Rotary Pumps and Recent Developments," by R. J. S. Piggott; and "Selection of Economic Electric Motor Equipment for Pipe Line Pumping Stations," by W. H. Stueve. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary.

**May 26—**

**Century of Progress.**

International exposition opens for 1934 on this date. New and revised industrial exhibits will be included. Information may be obtained from Lenox R. Lohr, general manager, administration building, Burnham Park, Chicago.

**May 28-30—**

**American Institute of Radio Engineers.**

Annual meeting and exposition to be held at Philadelphia. Harold P. Westerman, 33 West Thirty-ninth street, New York, is secretary.

**June 17-22—**

**Society of Automotive Engineers.**

Annual summer meeting to be held at Saranac Inn, Saranac Lake, N. Y. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

**June 18-20—**

**American Society of Agricultural Engineers.**

Annual summer meeting to be held at Detroit. Raymond Olney, St. Joseph, Mich., is secretary.

**June 18-21—**

**Inform-A-Show.**

Meeting of National Association of Purchasing Agents and annual exhibition to be held at Hotel Cleveland, Cleveland. Ralph G. Sweeney, Allyne Ryan Foundry, Cleveland is general convention chairman.

**June 19-21—**

**National Aeronautic and Hydraulic Meeting.**

The aeronautic and hydraulic divisions of the American Society of Mechanical Engineers will hold a joint meeting at the University of California, Berkeley, Calif., during the summer meeting of the American Association for the Advancement of Science. Prof. B. M. Woods of the University of California is in charge of the meeting arrangements.

**June 20-23—**

**Oil and Gas Power meeting.**

Annual technical session of this division of the American Society of Mechanical Engineers will be held at Pennsylvania State college, State College, Pa. Exhibits are in charge of Professor de Juhasz of the college.

**June 25-28—**

**American Society of Mechanical Engineers.**

Semiannual meeting of the society to be held at Cosmopolitan hotel, Denver, Colo. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary.

**June 25-29—**

**American Society for Testing Materials.**

Annual meeting to be held at Chalfonte-Haddon hall, Atlantic City, N. J. C. L. Warwick, 260 South Broad street, Philadelphia, is secretary of the society.

**June 25-29—**

**American Institute of Electrical Engineers.**

Annual summer meeting to be held at The Homestead, Hot Springs, Va. H. H. Henline, 33 West Thirty-ninth street, New York, is secretary of the electrical society.

**July 3-9—**

**International Congress for Applied Mechanics**

Fourth annual congress to be held at Cambridge, England. Information on the meeting may be obtained from the American Society of Mechanical Engineers, 29 West Thirty-ninth street, New York.

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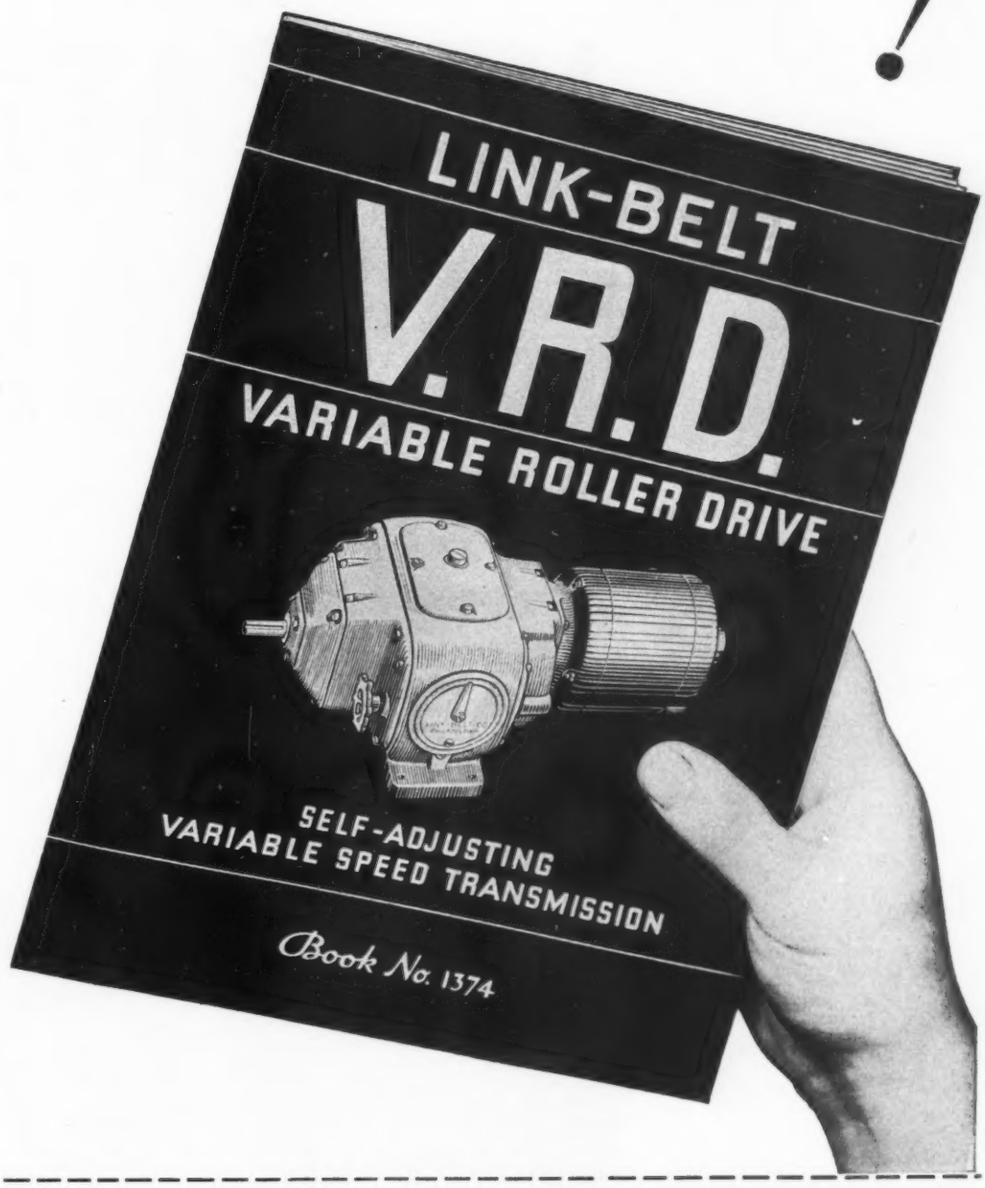


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MACHINE DESIGN

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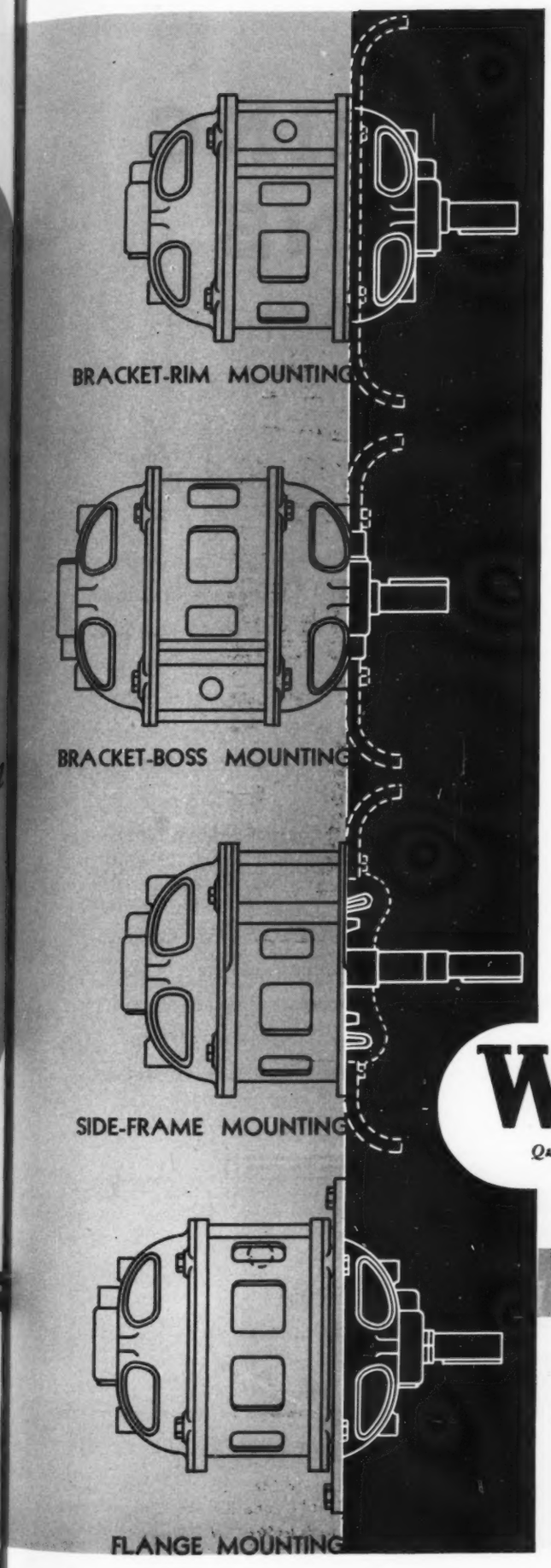


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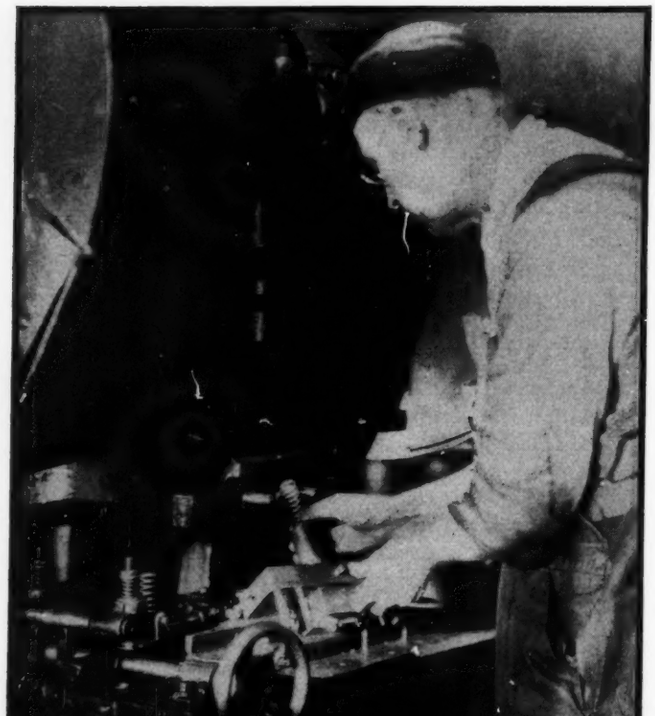
# SOLVING UNUSUAL SPRING APPLICATIONS



$$n = \frac{1}{\frac{S_o}{S_y} + \frac{S_v}{S_e}}$$

WITH springs playing a vital part in the operation of most machinery—it is essential that their design be given the utmost care and attention. This applies particularly where special or unusual conditions exist—and where new and untried service is called for. In such instances, formulae, to arrive at a working hypothesis without error, must be based not alone on stress, torsion and other set conditions of operation—but, also, on such important factors as the tensile and fatigue properties of the material used. The thorough familiarity of American Steel & Wire Company technicians with the structural forms of metals—and the application of these metals to spring design—has played an important part in the successful development and use of springs.

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MACHINE DESIGN
THE JOHNSON PUBLISHING CO., CLEVELAND, OHIO
May, 1934 Vol. 6—No. 5

# Combining Utility, Looks with Medium Cost

By R. J. Jauch
*Manager, Experimental and Research Departments, Wayne Co.*

GASOLINE pumps must appeal not only to the buyer but to the customer who purchases the product dispensed from the equipment. It might be said that buyer appeal in design is the goal of the pump designer, and this in itself might not prove difficult. However, the units hidden under the housing largely dictate the limits to which the designer can go.

When meter pumps, Fig. 1, first made their bid to supplant the visible type, builders of gasoline dispensing equipment purchased many of their units from various manufacturers. Little test data was available to assist in choosing the proper pump, meter or clock to use in this new field and all manufacturers relied to a great extent on the knowledge gained in similar lines. Today these same companies produce practically every important part with the exception of the motor. This enables

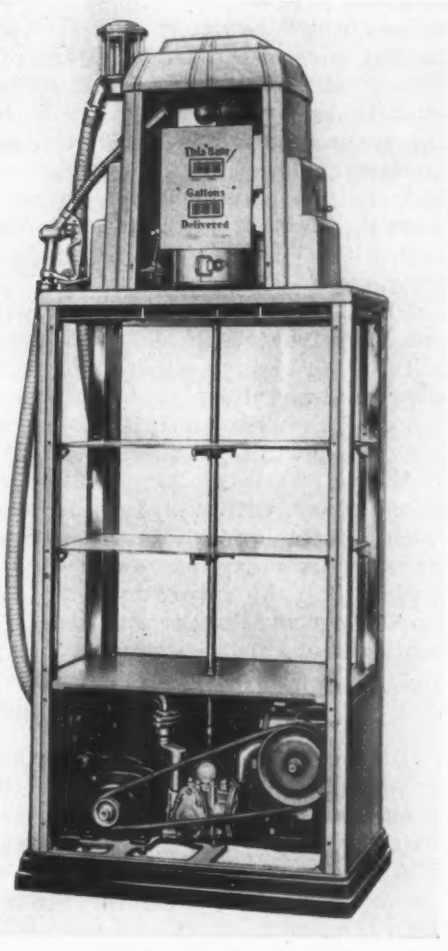


*Fig. 1—Complicated mechanisms, appearance, materials, and user acceptance must be considered in pump design*

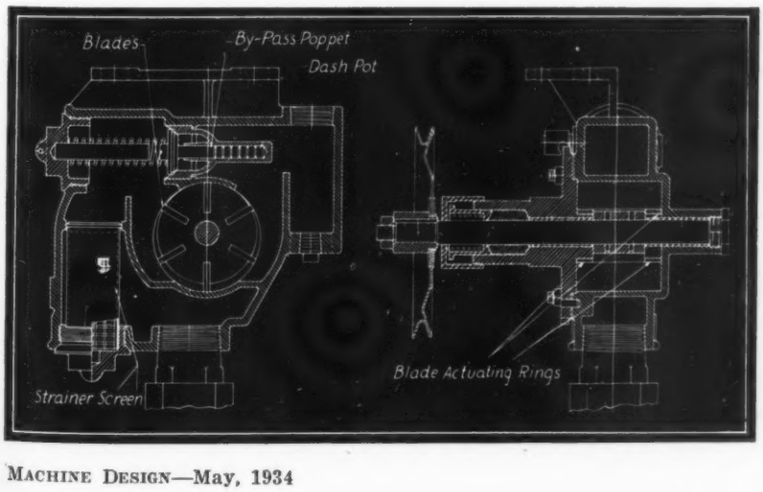


*Fig. 2—Composition blade material is designed to maintain absolutely accurate clearances in gasoline pump*

the engineering department to change to more suitable materials quickly when conditions demand without first having to consult outside manufacturers, and gives the engineer greater leeway for new design.

The pump, *Fig.* 2, perhaps the most important unit in dispensing equipment, appears at first glance to depart little from the ordinary vane type of rotary pump. Due to a decided preference on the part of engineers for pump speeds not to exceed 700 revolutions per minute, high vacuum in this type of pump is attained only so long as close tolerances are maintained between rotor and case, and the blades kept in wiping contact with walls.

### Reaming Is Facilitated

To facilitate line reaming, the case is bored and this hole is later tapped and plugged. The oilless bronze bearings used are each 2 inches in length and have a lead content of 20 per cent. This type of bearing prevents scoring of shaft even though the pump is run without liquid or lubricant of any kind. The length of bearing surface has been found extremely important, as it largely determines the life of the unit. Any wear on the bearing causes the rotor to lose contact with the case, resulting in a loss of efficiency.

Pump blades are of composition material, specially treated so as to maintain dimensions within 0.0015 inch when submerged in gasoline over an indefinite period, and are fitted into the rotor slots with an initial clearance of 0.002 inch. A peculiar characteristic of this material is that a swelling of approximately 0.0005 inch takes place within a few days after running with gasoline and gradually increases in seventy days to its maximum swell of 0.0015 inch, at which time the saturation point is reached and no further swelling takes place. There still remains 0.0005 inch between rotor and blades.

### Steel Rings Are Employed

Because of the lightness of this material when compared to brass or steel, centrifugal force alone cannot be relied upon to keep the blades at all times against the wall of the pump body. For this reason two steel rings are positioned one on either side of the rotor to force the blades into engagement with the wall. To guard against foreign matter such as sand or dislodged pipe scale, entering the pump, a monel metal strainer screen of 100 mesh is provided through which all liquid passes before entering the rotor chamber.

A by-pass of the poppet type is also arranged within the pump and has at its one end a lug over which is placed an electrically heat treated steel spring (cadmium plated) of predetermined weight; the spring is piloted by a brass rod inserted into a screw plug. Formerly a bronze spring had been used but due to the action of sulphur contained in some gasolines, the spring became brittle and much breakage was experienced in field service.

Without going into the principles involving the operation of the meter, it has been illustrated in *Fig.* 3 to show just what can be done to reduce cost without sacrificing performance. The meter case, formerly made of cast iron, has been changed to a zinc die casting and weighs approximately ten pounds. Its many cored openings presented a difficult casting problem and

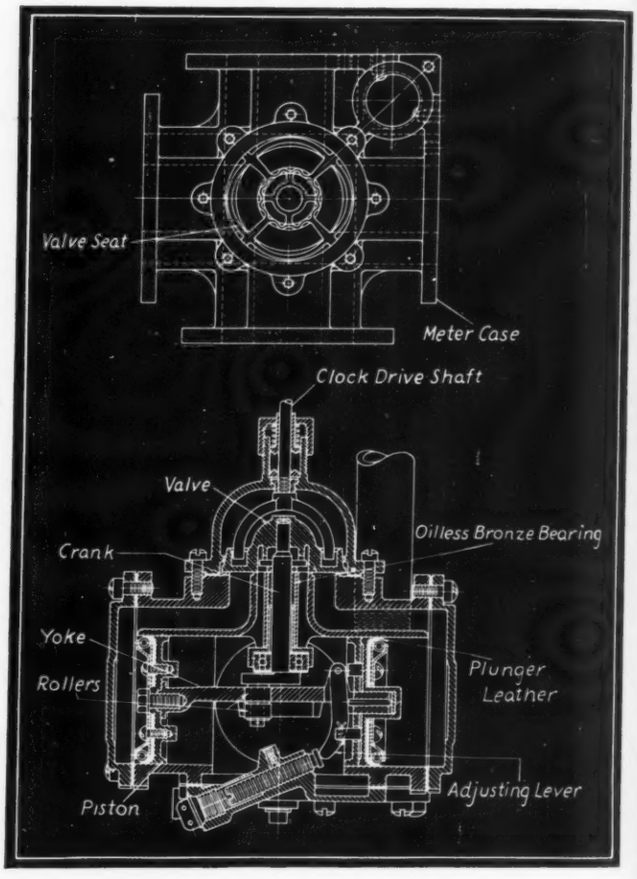


*Fig. 3—Use of zinc die castings in meter reduces costs and improves servicability of the unit*

while minor changes were made to assist the die casting manufacturers, the brunt of the problem was left entirely to their engineering department. In addition to the meter case, the pistons, yokes, valve, bottom plate and end flanges are die cast zinc. All are heat treated to reduce strains. The crankshaft and rollers are of monel metal, while the ball bearing supporting the crankshaft at its lower end is of stainless steel.

A hint that may prove helpful to anyone considering a rotary seal may be had by studying the valve seat of the meter body. This snake-like seat was designed to extend the contact over a greater area of the valve without increas-

ing the frictional surface. Though the valve travels in a true circle, it has all the advantages of an orbitary movement in that the valve face is being constantly lubricated, the revolving valve wiping off the liquid with a knife-like action.

Both the amount of liquid and the total price of liquid dispensed by the pump, regardless of the unit cost, are registered on easily readable dials by the computing mechanism shown in *Fig.* 4. The quantity dispensed is indicated to the fraction of a gallon, while adjustments permit exact cost computations based on unit costs varying by one-tenth of a cent.

The quantity record is operated by a shaft

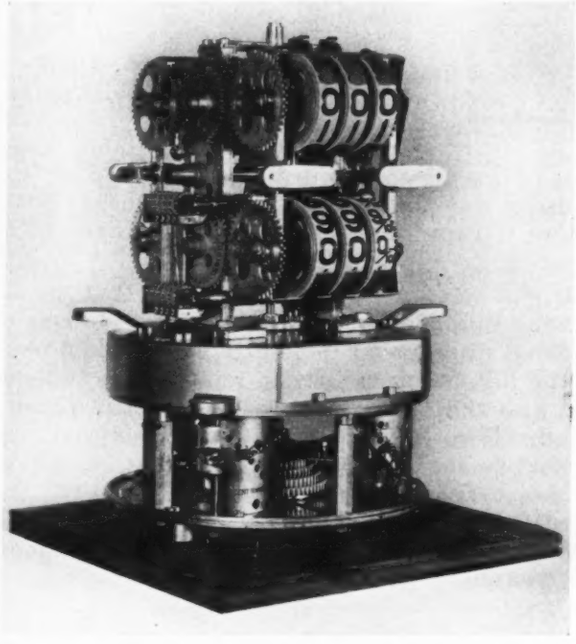

*Fig. 4—A differential gear system aids accurate computation of total sale figures*

connected to it through suitable gearing and receiving its motivation from the meter drive shaft through a universal joint. This gallon take-off shaft is journalled in the bottom and top plates as shown in *Fig.* 5. The speed variator mechanism, which controls the cost record, has no effect whatever on the gallon indicator.

Operation of the speed variator mechanism is on the well known differential principle used on all automobiles. The primary motion is obtained from a cone gear cast on to the gallon take-off shaft. This cone gear is made up of nine step gears, the small gear at the top having eight teeth and eight additional teeth being used in each step toward the bottom until the large bottom gear has 72 teeth. The cone gear, as it is rigidly connected to the gallon take-off shaft, is controlled entirely by the meter which has a fixed number of revolutions for every gallon dispensed.

Equally spaced around the cone gear are three hexagon shafts, journalled for rotation in the top and bottom plates. Slidably mounted on each shaft is a gear which is journalled in a bell crank, serving also as a shifter lever. Each shifter lever also carries an idler gear that meshes with the slidable gear on the hexagon shaft. The shifter levers co-operate with plates that have been drilled with holes to correspond to each of the gear steps on the cone, so that when the pin is engaged with the selected hole, the idler gear is held in any desired position on the cone gear. Thus the idler can be adjusted to mesh with any of the nine gears on the cone and by this contact be rotated, and rotate the slidable gear and hexagon shaft, at any of the speeds provided by the nine gear ratios.

### Differential Gears Used

Another gear is rigidly fixed to each of these hexagon shafts. These three fixed gears mesh with the differential gears which are rotatably mounted on the shaft carrying the cone, *Fig.* 5. The first step in this train drives directly through to the first set of differential gears. The next step, by driving a differential plate, increases the speed and the consequent reading. A second set of differential gears accommodates the third factor in the computations, and adjusts the final speed of the shaft so that the money take-off will register the correct amount.

Each hexagon shaft has a different ratio of gearing and produces a definite range. For example, one range provides for 1/10 cent variance from 0/10 to 9/10. A second adjusts in even cents, 0 to 9, and the third jumps 10 cents for each step on the cone gear, 10-20-30, etc. If a price of 18 2/10 is desired, the sliding arm communicating with the plate marked 10-20, etc. would be positioned in hole marked 10c. The arm communicating with the 1c range plate would have pin placed in hole marked 8c, and the 1/10 range plate would have pin positioned in hole marked 2/10. The total of the three, 18 2/10, will be indicated on the money clock.

### Cost Reduction Paramount

All of the problems encountered in this design and how they were overcome would require too much space for discussion at this time, but the most serious one was the necessity of constructing the unit at a price that would not prohibit its use. Dispensing units receive very little attention from their owner when once put in service and for that reason oilless bronze bushings are used at every important bearing point. Stampings and zinc die castings make up the largest percentage of parts in the device. The unit is sturdy in construction, accurate in its computations and has proved itself troublefree in operation.

Constantly changing habits of the buying

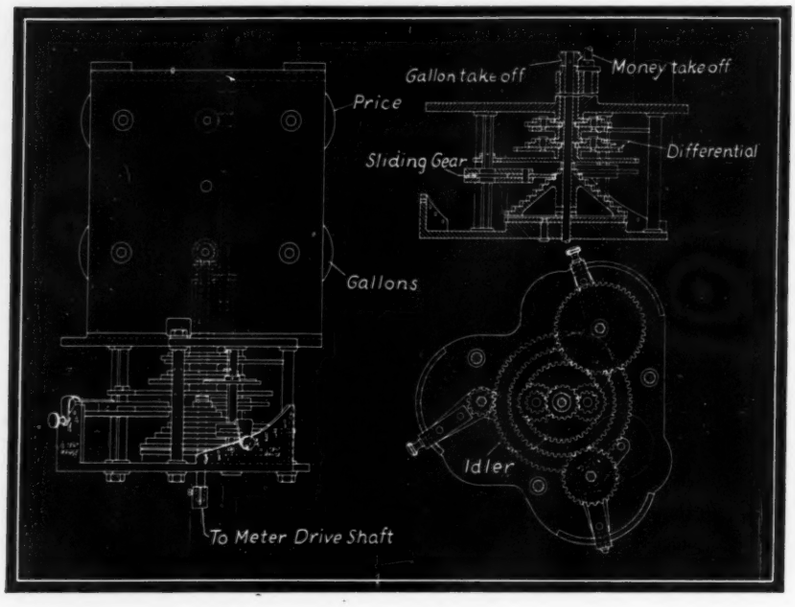


*Fig. 5—Nine-step cone gear permits adjusting for small differences in unit sales costs*

public prompted the idea of combining a display cabinet with a dispensing pump. The motorist, having become accustomed to it, now expects the free service rendered by an obliging attendant, and while thus being momentarily delayed, he is reminded of the need for some item that he thought perhaps could only be purchased elsewhere, if the merchandise is properly displayed.

### Appearance an Important Factor

In designing this unit, proper proportions and balanced appearance was obtained by building a model of wood, so constructed that the dimensions of the entire cabinet could be easily altered. This applied not only to the corner posts but to the base and top as well and was accomplished through the use of mortised sections that permitted widening or narrowing the base, as well as increasing or decreasing the height of the corner posts.

From the start it was realized that good illumination was not only of prime importance but was an absolute requisite. Shadows had to be carefully avoided and an even distribution of light on all shelves was finally gained by placing the bulbs in a position where the rays would reflect on the glass panels and shelves, distributing the light to the bottom as well as the top. These tests were conducted in a darkened room, using wooden blocks of various shapes and sizes to duplicate cartons of cigarettes, cans of oil, etc.

Pumps, motor and meters require occasional service and replacement in the field. Each unit therefore, is placed in position where it is readily accessible. By mounting the units rigidly to the base all fastenings tieing to the corner posts are eliminated, thereby reducing to a minimum vibration that might otherwise travel to the shelves. Since it is almost impossible to make a watertight canopy, every precaution was taken to reduce to a minimum the amount of water that might enter during a driving rain or snow storm. Anticipating that some water would enter, the top blinder has been formed to an angle of one degree extending away from center with edges turned up $\frac{3}{8}$ inch and extends to the extreme ends of the cabinet, forming a trough. Thus, any water entering the canopy drops to the drain pan or blinder and finds its way into one or all of the corner posts, where it runs to the base and out to the pavement.

It will be seen from the foregoing that the designing engineer is confronted with a series of unusual problems. Frequently he is looked upon in the light of an artist, an imaginative individual who sits back and creates a mental picture of something that is appealing. When you stop to realize the many collateral points that have to be taken into consideration, vitally, the problems of the designing engineer become involved, intricate, difficult and sometimes almost unsolvable.

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# *They Say—*

"A well designed product pays from the moment it is seen by the consumer on through its life by earning and retaining a high regard."—Ben Nash, industrial designer.

□ □ □

"The affirmation that science and the machine are responsible for the world crisis and unemployment must be definitely rejected. They have made it possible for man, with enormously reduced effort, still to have everything he needs for a life of comfort."—Guglielmo Marconi.

□ □ □

"In every line, products that are taken for granted as being "all right" because they were readily salable during the boom days are going to be shown up as obsolete by the improved products of the wide-awake minority who set the pace —and capture the market. . . . All of which leads to the fact that all through industry *redesigning time is at hand."—Aluminum News-Letter.*

# Determining Moments of Inertia

By C. H. Powell

DETERMINATION of the center of gravity and moment of inertia of any given section is a necessity in design that requires a disproportionate amount of time, especially if the section departs in the slightest from a regular geometrical pattern. In order to lessen the design labor connected with this task, there has been developed a quick graphical method of computation that can be used with equal facility on all sections. The principle on which this method is based is nothing more than that of the standard graphical method of the strength of materials text books. The following way of using that principle, however, is found in practice to be much quicker.

### Three Co-ordinates Used

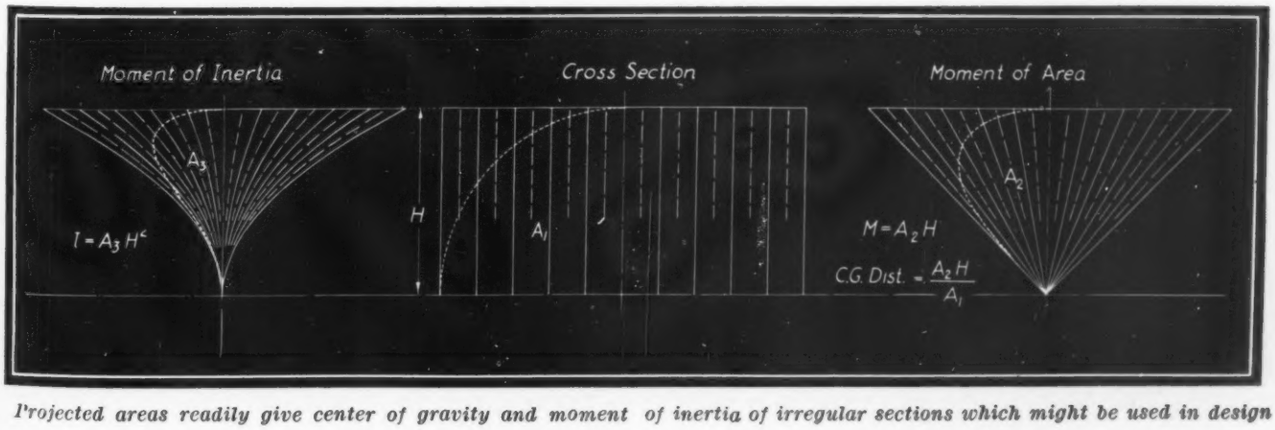
Three sets of co-ordinates are drawn, rectilinear in the center, radiating straight lines on the right and parabolic on the left, as shown in the accompanying illustration. The cross section whose moment of inertia and center of gravity it is desired to find is drawn on the central rectilinear co-ordinates and the axis about which the moment of inertia is to be determined is made to coincide with the lower horizontal axis of the co-ordinates.

If the center of gravity is desired, then the cross section is horizontally projected on the fan shaped co-ordinates at the right. For the determination of the moment of inertia, the figure is transferred, also by horizontal projection in a similar way, to the parabolic co-ordinates at the left. This is quickly done with the Tee square. The inclined lines of the fan and the parabolas of the left-hand figure correspond with the vertical lines of the original central figure. A quadrant is shown treated thus in the accompanying figure. In practice, the cross section and its transformations are drawn on transparent paper that is placed over the sets of co-ordinates which need be drawn only once. These co-ordinates can be used indefinitely for any number of sections.

Having these three figures, determine their areas by planimeter. Let $A_1$, $A_2$, $A_3$ be the areas of the figures on the rectilinear, inclined and parabolic co-ordinates respectively. Let $H$ be the height at which corresponding divisions, horizontal, are equal in all three sets of co-ordinates, independent of the shape of cross section. Then:

$$\textit{Moment of inertia} = A_3 \times H^3 \ (\textit{length units})^4$$
$$\textit{Moment of area} = A_2 \times H \ (\textit{length units})^3$$
$$\textit{Center of gravity distance from axis} = (A_2 \times H)/A_1 \ (\textit{length units})^1$$

To find the polar moment of inertia, first find the moment of inertia in the manner shown. Then turn the cross section through 90 degrees and repeat the process. This is equivalent to finding the moment of inertia about the vertical axis. The axis about which the polar moment of inertia is desired passes through the intersection of the vertical and horizontal axes and is perpendicular to both. The sum of the two moments of inertia is the value of the polar moment of inertia.




*Projected areas readily give center of gravity and moment of inertia of irregular sections which might be used in design*

# SCANNING THE FIELD FOR IDEAS

## AUTOS SET PACE FOR TRACTORS

DESIGN flourishes on ideas! Every alert engineer is aware of that. Nearly every day some new machine looms up to impress a never-ending procession of innovations on a receptive audience. Not long ago the railroads emerged from a state of lethargy. No doubt the automotive industry played a large part in setting an example of what can be accomplished by change and the adoption of new ideas. The influence of this wide-awake industry now is reaching into another field—that of agriculture.

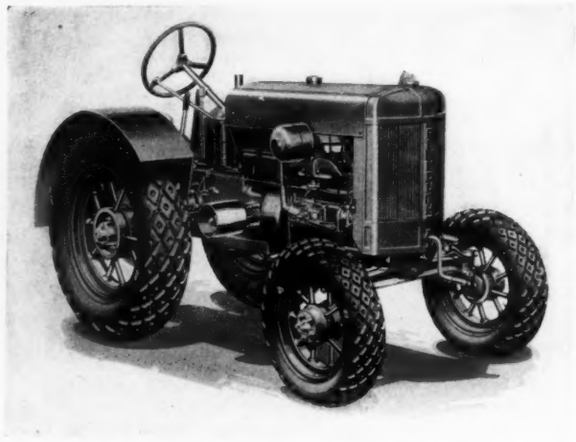


*Fig. 1—Illustrative of a new era in tractor design, this unit has eye appeal besides mechanical innovations*

One of the first agricultural units to reflect distinct automotive trends is the Fate-Root-Heath tractor, *Fig.* 1, with its pneumatic tires, V-type radiator, four-speed transmission and a rear axle sealed against dust and dirt. Wheel hubs are equipped with antifriction bearings. Like an automobile, the wheel is separate from the hub, being held to it by nuts. Carrying out the modern design motif, the hood and gas tank have been combined to add to the symmetrical appearance.

## SPARE TIRE ACTS AS BUMPER

ONE of the more recent ideas in automobile bumpers is the use of the spare tire for this purpose. A new Swedish streamlined car utilizes the innovation. Inasmuch as the rear extremity of the body converges almost to a point, the protruding portion of the tire which lies flat in a slot-like recess affords ample protection. And while on the subject of foreign automotive design, it is noteworthy that new model cars i nthe Berlin exposition revealed a trend toward independent springing of all four wheels and improved front-drive systems.

## WHIRLING STEAM FOR SEPARATION

NUMEROUS examples of the use of centrifugal force already have been discussed in these columns. The various ideas presented employ one of nature's most fundamental and dependable laws. A recent addition to this list of applications is a separator of simple but unique design, *Fig.* 2. By positioning a helix or "corkscrew" device near the inlet of the unit an arrangement is provided which gives steam, air or vapor a whirling motion as it enters. Therefore, any liquid or solid matter that is entrained in the stream is thrown by centrifugal force to the outside of the separator where it collects, runs down and is drawn off. Because no baffle plates are employed a high degree of

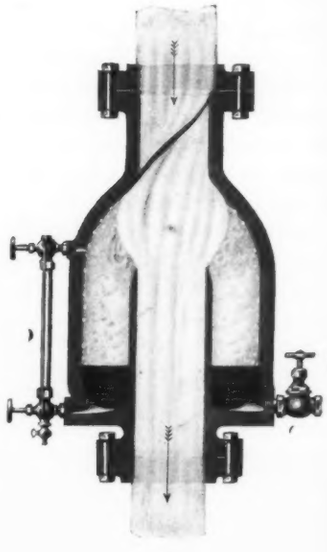


*Fig. 2—Steam is given a whirling motion by a helix near the inlet of this unit. Thus any liquid or solid entrained is thrown to the outside of the separator where it collects, runs down and is drawn off*

separation is attained with practically no pressure drop. Swartout Co., Cleveland, is introducing the separator.

## GRINDING TUBES INTERNALLY

DESIGNERS undoubtedly will be interested in the manner in which one company has solved the problem of grinding and polishing the interiors of tubes and pipes. An endless

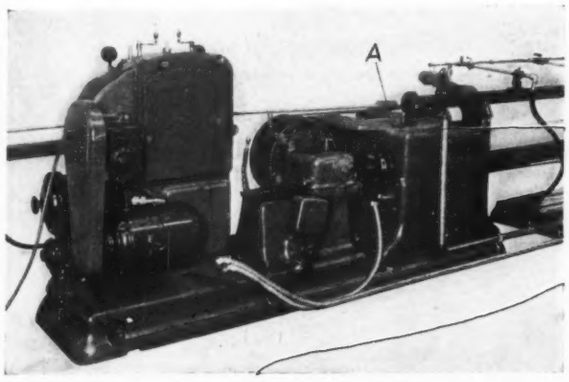



*Fig. 3—An expansible head exerts pressure against an endless abrasive belt to grind tubes internally*

abrasive belt traveling around pulleys at either end of the machine, and through the pipe, imposes a finishing operation on the internal surface. One of the unique features is the pneumatic head by which grinding pressure is obtained. Air pressure is introduced into the head through a hollow ramrod on which it is attached. This head, designated *A*, *Fig.* 3, is introduced into the pipe, and through expansion exerts the desired pressure on the flexible coated abrasive belt. The ramrod is power driven in both directions; reversal is automatic. A water spray cools the work to allow fast cutting. Mattison Machine Works, Rockford, Ill., developed the unit which is intended primarily for stainless steel tubes and pipe; pipes of other metals can of course be processed.

## WILL STREAMLINING HIT BOATS?

STREAMLINING is a topic that has engaged engineers in all walks of the profession. They have watched intently the automobile, railroad trains and airplanes demonstrate its practicability. Attention now is turning to boats which, as *Power Boating* says, have clung to the traditional forms of the past. This publication under the heading "Will This Be the Standard Model of 1944?" discusses in its May number a design developed by Elliott Gardner.

Outlining a few of the features, the bow of the boat tends to part the air in a horizontal plane instead of on a vertical plane as does the conventional hull. This aids in obtaining lateral balance which prevents the bow from being blown around faster than the stern when maneuvering in a beam wind. The bottom is not as flat as one might expect; it has much more deadrise than any hydroplane and does not terminate suddenly in a transverse step. A sharp forefoot is carried a few inches above the surface. The low angle of incidence gives remarkably smooth riding in choppy water.

There is a single step that runs diagonally in a long V. The keel cuts off just forward of amidships, but the chines continue to a point over two-thirds of the way to the stern. This reduces wetted surface to a minimum and causes the boat to ride the surface on a large V-shaped plane.

## USE SPRINGS TO RELIEVE SPRINGS

ADDITION of a tappet spring in each valve train of the 1934 Chevrolet automobile engine is one of the more recent ideas embodied in automotive design to reduce noise to a minimum and insure easier valve action. This extra spring, *Fig.* 4, seats on a collar *A* at the lower end of the push rod, while its upper end bears against a retainer stamping *B* fastened to the ledge of the crankcase. Each spring exerts a pressure of 41 pounds between the push rod, tappet and cam surface when the valve is open and 18 pounds when the valve is closed. This spring pressure at the lower end of the valve train maintains constant contact between the operating parts and relieves the valve seats and valve retainer parts at the upper end of the train of some pressure. Division of spring load in the valve train is an important factor in the

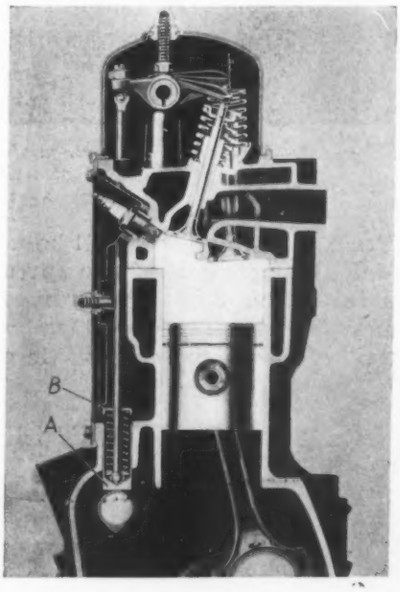



*Fig. 4—Use of an additional spring in each valve train, in the tappet, relieves the valve spring of part of its load. The result is less noise and better valve action. A lighter valve spring also is permitted*

quiet operation of the mechanism and increased durability of the parts.

The valve springs insure positive seating under all conditions, and periodic surge is prevented. With the double spring arrangement, the valve springs are required to carry only the inertia loads imposed by the valves and rocker arms; push rod and tappet inertia loads are taken by the tappet springs.

## RESILIENCE COMBATS DISTORTION

SELF-ALIGNMENT of flexible rings comprising the friction elements of a new clutch automatically distributes pressure uniformly over the entire friction surface. Coadjustment is secured through employment of resilient, conical friction rings which telescope under wedging action as axial shifting force is applied. Outer rings are stretched and inner rings compressed.

Illustrating the principle embodied in the Fast clutch, *Fig.* 5 shows a partial section of the friction rings in three different axial positions.

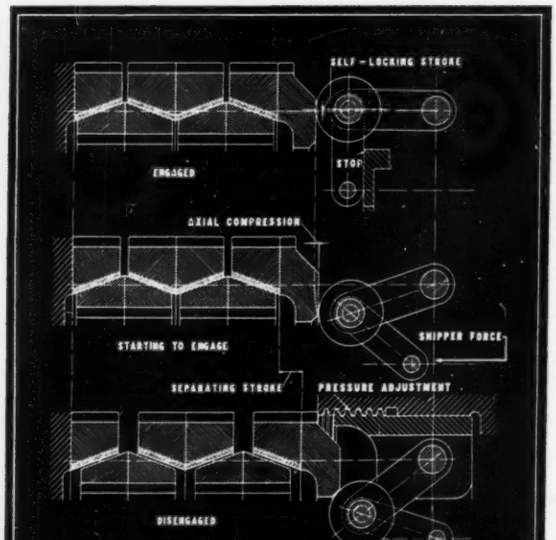



*Fig. 5—Resilient friction rings of clutch act as compressed springs to effect uniform pressure*

From the top view it will be noted that the friction elements act as a compressed spring. When axial clutch pressure is removed the rings will snap apart. The coadjusting features of the unit compensate for possible errors.

## REDUCING SPEED IN LIMITED SPACE

WHERE speed reduction must be confined within limited space, a mechanism such as that shown in *Fig.* 6 may find many useful applications. This planetary gear reduction device is embodied in a small can sealing machine built by Dixie Canner Co., Little Rock, Ark. Internal gear *A* is mounted concentric with shaft *B* which carries eccentric hub *C*. Spur gear *D* rotates around and with eccentric hub *C* as the center shaft is rotated.

Pins, *E*, eight in number, are mounted in spur gear *D* and extend downward into holes *F* provided in cam *G*. Because internal gear *A* has 44 teeth and spur gear *D* 40 teeth, it is evident the spur gear will change its position in relation to the internal gear four teeth or one tenth its total number each time the center makes one

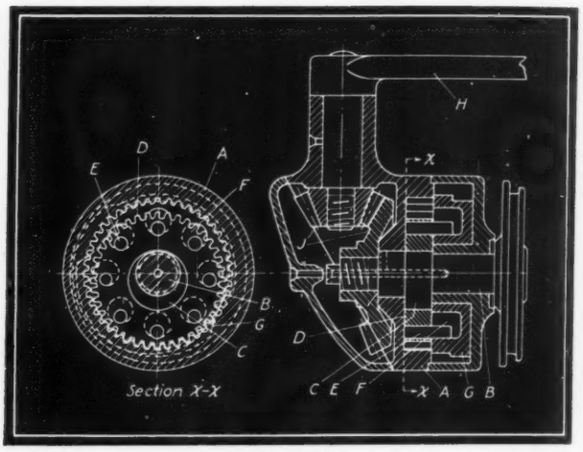



*Fig. 6—Planetary gear reduction mechanism embodied in can sealing machine furnishes unique idea*

revolution. Thus a ten to one reduction in speed is obtained in an exceedingly compact mechanism.

Since pins *E* extend downward into holes *F* as shown, the motion of the spur gear is transmitted to cam *G*. If holes *F* are exactly twice the diameter of pins *E* and equally spaced the pins will follow the side walls of the holes in each cycle of operation. A further reduction for hand crank *H* is provided by means of bevel gears *J*, transmitting power to the center spindle as indicated. Many parts including gearing, are zinc die castings.

## NEW MATERIAL COMBATS NOISE

DESIGNERS are exhibiting a great deal of interest in the development of a new sound absorbing and insulating material. It has an asphalt base in which a soft filler is incorporated. Supplied in liquid form, the material can be applied with spray gun equipment. Temperatures within the range of 30 degrees below zero to 250 degrees Fahr. have no effect on it. Spraytex, as the improved material is known, was developed by The Monroe Auto Equipment Co., located at Monroe, Mich.

*Fig. 1—Machine parts which contact abrasive materials, such as this conveyor screw, or parts for use in locations where grit is present should be hard-faced*

# Hard-Facing, Inserts and Plating Satisfy Hardness Requirements

By Allen F. Clark
*Associate Editor, Machine Design*

IT IS well known that strength and hardness of metals do not necessarily go hand-in-hand. Many machine parts, tools and implements must be, by their very design or the nature of the work they are to perform, extremely strong. If such parts are made of tool steel and heat treated, a compromise between hardness and strength must generally be accepted.

Obviously a better compromise condition should be developed. Contrary to all precedent, the compromise in this case offers a better solution to the problem from all angles than any of the original propositions. It has now become a simple design expedient to specify at low cost material for the part in question that will exactly satisfy strength considerations, and then specify a facing for this part that easily resists the wearing or eroding forces that might be present. Other methods of solving this same problem, to be covered in future issues of MACHINE DESIGN, include the use of alloy inserts and the employment of chromium plating for wear resistance.

When the original design calls for hard-facing, the designer may select a steel for the body or bulk of the piece that is expressly suited for strength requirements. Only the strength and cheapness of the base metal need be kept in mind. By hard-facing the wearing surfaces, a composite machinery part is obtained which possesses both strength and hardness where needed, thus assuring an ideal combination of the desired properties.

Hard-facing is the process of welding on to wearing parts a coating, edge or point of a metal highly capable of resisting abrasion. In this way a metal surface, which due to its use may be worn away rapidly, can be protected by a layer of special alloy which possesses exceptional resistance to abrasion. The process materially increases the life of a part subjected to abrasive forces.

No one hard-facing material is suitable for the hundreds of different applications and conditions encountered. Therefore, in considering applications of hard-facing, particularly new or

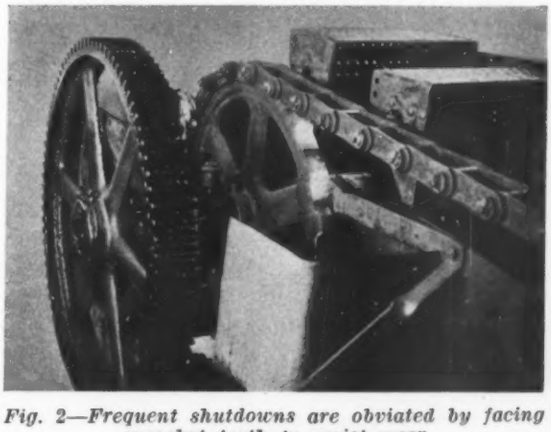


*Fig. 2—Frequent shutdowns are obviated by facing sprocket teeth to resist wear*

uncommon ones, the conditions under which the part works should first be thoroughly studied before a specific material is selected. A number of hard-facing materials that are available in welding rod form are shown in the accompanying table. This table is given as merely a guide to the available types; the hardnesses are those obtained in the welded deposits made by these rods without subsequent heat treatment, which later may increase the hardness slightly in some cases. Repeated heat treatments ordinarily are not recommended however. Final choice should be made only after consultation with a specialist in the application of hard-facing materials.

### Three Groups Available

There are three general classifications into which all types of hard-facing materials can be grouped. The first of these comprises alloys having iron base and containing such elements as chromium, tungsten, manganese, silicon and sometimes cobalt and nickel. The second class is composed of nonferrous alloys, and the third class consists of the so-called diamond substitutes which are essentially tungsten carbide.

The materials carrying high hardness, such as the tungsten-carbide group and the cast alloys ranging from 534 to 578 brinell, naturally will not stand extreme shock. They are used, properly backed up, as cutting agents for going through rock and hard earthen formations and where extreme sliding abrasion is encountered.

Parts subject to shocks and blows, such as clutch faces and dogs, require a material with some degree of toughness. This class ranges in hardness from 375 to 444 brinell.

Some applications require a smooth, ground finish. Others must resist an acid or corrosion condition requiring the selection of a corrosion-resisting hard alloy. The cost of the application should, of course, also be considered in the selection of the hard-facing material which will prove the most economical, consistent with being satisfactory in other respects.

In designing parts for hard-facing, consideration must be given to certain fundamentals. The overlay must be welded on and the method of welding to employ must be carefully selected. Any modern welding method involves the application of heat—in most cases localized. This tends to cause warping or distortion which sometimes must be guarded against by preheating or jigging the part before hard-facing. In any event, machine parts should only be rough machined before the overlay is applied. After hard-facing, finish machining or grinding will take care of any movement caused by the welding operation. Parts requiring subsequent heat treatment should first be rough machined, then hard-faced, then heat treated (oil quenched only), drawn when required and finally ground to finished size. There have been special wheels developed for bringing parts down to size.

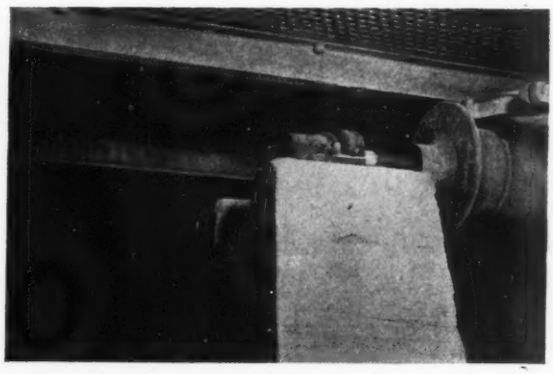


*Fig. 4—Drag line shaft in cement machinery operates in extremely dusty atmosphere*

*Fig. 3—Digging teeth and surfaces contacting rock were hard-faced in original bucket design*

### Should Consider Limitations

Hard-facing, like every other process, has its limitations. While there are hundreds of applications where hard-facing can be applied to advantage, there are also cases where it should not be recommended. With certain steels it is possible to obtain a hardness of 70 on the Rockwell C scale by heat-treatment. For small parts in particular, there are numerous instances where heat-treating is much superior and more economical than hard-facing. This field is not open to hard-facing. On the other hand, where due to friction or other cause, sufficient heat is generated to draw the temper or hardness from heat-treated steel, hard-facing alloys some of which hold their hardness even at red heat, are far superior and more economical.

## Characteristics of Typical Hard-Facing Welding Rods

| ROD | COMPOSITION | FIELD | BRINELL HARDNESS As Deposited By Oxy-acetylene | BRINELL HARDNESS As Deposited By Arc | REMARKS |
|---|---|---|---|---|---|
| Borod | Tungsten, iron carbon | Utmost abrasion resistance | 745 | | Corrosion resistant |
| Hardweld | High carbon steel | Shock, abrasion resistance | | 197-285 | |
| Hascrome | Chromium, manganese iron | Moderate abrasive wear or severe impact | 240-500 | 240-400 | Self-hardening |
| Haynes Stellite 1 | Cobalt, chromium tungsten | Extreme abrasive wear and slight shock or impact | 512 | 512 | Low coefficient of friction. Corrosion resistant. Retains hardness at red heat |
| Haynes Stellite 12 | Cobalt, chromium, tungsten | Fairly large areas where hair line cracks would interfere with operation | 444 | 444 | Low coefficient of friction. Corrosion resistant. Retains hardness at red heat |
| Haynes Stellite 6 | Cobalt, chromium, tungsten | Surface subjected to heavy shock or impact or for a keen cutting edge | 402 | 402 | Low coefficient of friction. Corrosion resistant. Retains hardness at red heat |
| Haystellite Composite rod | Grains of tungsten carbide distributed in a binding material | Utmost abrasion resistance | Composite deposit | | |
| Manganweld | Manganese steel | High shock and abrasion resistance | | 388-444 (Cold worked) | Tough, nonmagnetic |
| Stainweld | Nickel, chromium steel | Corrosion resistance | | | |
| Silfram | Iron, chromium, nickel, silicon, carbon | Parts subjected to hammering and shock | | 363-388 | Corrosion resistant. Nonmagnetic |
| Stoodite | Iron, chromium, manganese, silicon, carbon | Where abrasion is encountered | 545-590 | 514-545 | Nonmagnetic |
| Stoody | Iron, chromium, manganese, carbon | Parts subject to considerable shock or blows | 375-444 | | Tough, ductile and malleable. Self-hardening. Can be forged |
| Timang | Manganese steel | Characteristics of 12 per cent manganese steel | 450 (Cold worked) | | |
| Tube Borium | Granules of borium in a fabricated tube | Cutting edges, surfaces in contact with very abrasive substances | Composite deposit | | Matrix of mild steel with borium particles imbedded |
| Wearweld | Alloy steel | Rolling or sliding abrasion, repeated impact | | 351-545 | Self-hardening |

Every machine has its points of wear, some to a much greater degree than others, due to the varying conditions under which the parts work. A great many applications have been made, so many that even a mere listing would require too much space to be included in a short article. The relation of a few interesting ones may suggest applications to other designers.

### Cutting Edges Hard-Faced

One of the major fields of hard-facing is that group of machine parts which do not react with other parts of the machine, but are rather contact parts. This field includes tractor tracks, agricultural implement blades, digging teeth, augers and similar parts. For example, the design of the dragline bucket shown in *Fig.* 3 specified that it be faced for protection against excessive wear. A self-hardening iron, chromium, manganese carbon alloy was used.

All industries in which excessive dust or grit is liable to enter between wearing surfaces are ideal fields for the application of hard-facing. For example, the drag chain shafting in a cement plant, *Fig.* 4, was hard-faced with excellent results. Here the advantages of fewer replacements and far greater time between replacements was especially appreciated as the intense heat of the pit makes it necessary to shut down the whole kiln to replace any parts.

Another application of hard-facing intended to combat dust and grit between wearing surfaces, was the facing of a bottom guide bearing and bushing for a travelling agitator, *Fig.* 6. Although, in the previous design, the usual life of these parts was only 6 months, the faced bushings have been in operation for two years and are still in service.

In keeping with the precept that excessive wear necessitating frequent shutdowns can be avoided before it takes place, the sprocket teeth on beet elevators, *Fig.* 2, were successfully hard-faced, and the life of the machine materially increased.

These few examples barely touch upon the countless applications made in practically all industries. Undoubtedly the principal reason for

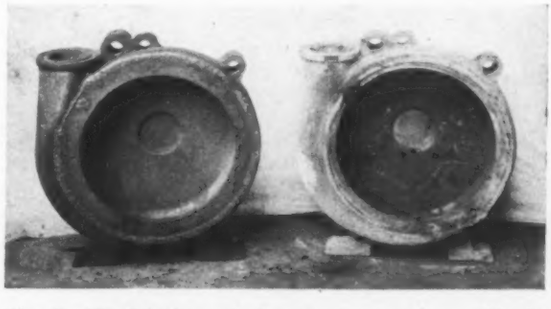


*Fig. 5—Hard-facing of slurry pump casings aids in maintaining them in continuous service*

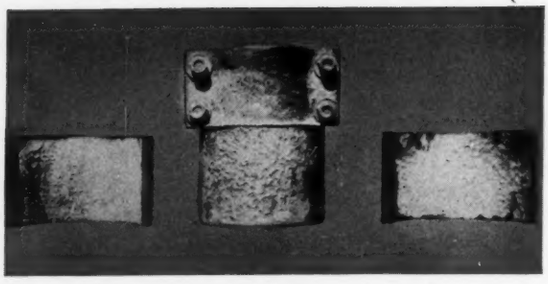


*Fig. 6—Dust between wearing surfaces is combated in guide bushings by hard-facing*

the remarkable increase in the use of hard-facings by industry which has occured during the relatively short period of time since they were first introduced, lies in the fundamental need for machine parts which will wear longer and be more efficient. Hard-facing has made possible the satisfactory solution of many vexing industrial problems and has provided the means by which substantial savings have been realized.

For their considerate co-operation in the preparation of this article, and for the illustrations used, MACHINE DESIGN wishes to acknowledge the assistance of Air Reduction Sales Co., Haynes Stellite Co., Lincoln Electric Co., and Taylor-Wharton Iron and Steel Co.

Articles on this and related subjects published in previous issues of MACHINE DESIGN include:
"Hard-Facing Metals Increase Life," Feb., 1931, p. 33.
"Protective Shielding for Blades Features Turbine Design," by C. Richard Soderberg, May, 1932, p. 40.
"Hard-Facing Increases Life of Monotype Molds," April, 1933, p. 46.

## Engineers Must Maintain Organization Contacts

THE engineer must put behind him the thought of designing, without consideration of the cost or facility of manufacture, the best machine of which he is capable. Instead he must design his machine with definite regard to the cost of production and adaptability to manufacture, according to Fowler McCormick, International Harvester Co., who spoke at a recent meeting of the Society of Automotive Engineers in Milwaukee.

The fundamental relation of engineering to manufacturing and distribution in any industry is, that it is the function of engineering to design machines which can be readily sold, and which can be manufactured efficiently and economically.

Both the sales and engineering departments play leading roles in the originating of new machines. It is an interesting question as to which should be charged with the responsibility of ascertaining what new machines are required, and what new ideas have the possibility of being worked out to a successful and practical conclusion. One might hold that the engineers, with their superior training, should be the ones to inquire constantly into the new needs. An opposite school could take the position that the sales force, outnumbering the engineers many times and being constantly in touch with the consumer, are the logical ones to sense the demands and pass the word on to the engineers. There is, of course, the third position, and it is probably the most practical, which contends that the engineering department members and those of the sales department should at all times continue this function, each supplementing the efforts of the other.

### Engineers Hold Full Sway

When we come to the actual process of designing it is obvious that we are in the realm where the specialized knowledge and training of the engineer holds full sway. Here, that knowledge which the engineer has gained through his experience in the field, the factory, and on the testing floor is brought into play, and he works for a time out of contact with the other departments. It is not until the experimental machine emerges for actual test that the manufacturing and sales departments again have a part to play in the process. At this point an opportunity is given the manufacturer to examine the drawings and actual parts to see if they are well designed for the process of casting, forging, machining, and assembly.

The sales department now comes into contact with the machine in its operation under actual tests, and representatives of that department inspect it to see if it complies with their ideas of what is needed to fill the demand.

In order that the engineering department may fulfill its true function, and so that the most satisfactory results may ensue, it would seem as if the three following general conditions must prevail.

In the first place, the personnel of the engineering department must be in close touch with the field. It must also understand manufacturing well enough to know how to design machines for manufacturing.

### Close Contacts Important

Secondly, it is of great importance that as close a personal contact as possible exist between the members of the engineering and sales departments, and the engineering and manufacturing departments. As the increase in the size of any organization has a natural tendency to separate the members, an effort must constantly be made to keep them in as close personal touch with each other as possible, so that the beneficial effect shall not be lost.

Third, for proper functioning there must be an understanding on the part of each department of the point of view and problems of the other departments, and a sincere desire to co-operate with and to assist each other.

# Surface Roughness Needs Attention

By E. J. Abbott
*Research Physicist, University of Michigan*

MATERIALS, dimensions, limits and parts are specified by the designer, but the roughness of the surface, that factor which is of paramount importance in determining fit, initial wear, lubrication and life is left to someone who scratches a finger nail across the surface and opines that it is good enough.

When an engineer wishes to specify a certain smoothness of a part, how shall it be done? And how can it be determined whether the surface meets the specifications? Until recently little had been known of the actual dimensions of irregularities which constitute roughness of a surface, and it appeared that before a practical means of specification could be devised it would be necessary to measure the physical differences in the profiles of the surfaces to be compared.

These measurements now are obtainable with an instrument for recording surface profiles called the profilograph, developed in the physics laboratories of the University of Michigan. The device consists essentially of a means of tracing over the surface with a sharp diamond point, the motions of which are communicated to a small mirror; this in turn draws on a strip of photographic paper an enlarged profile of the surface.

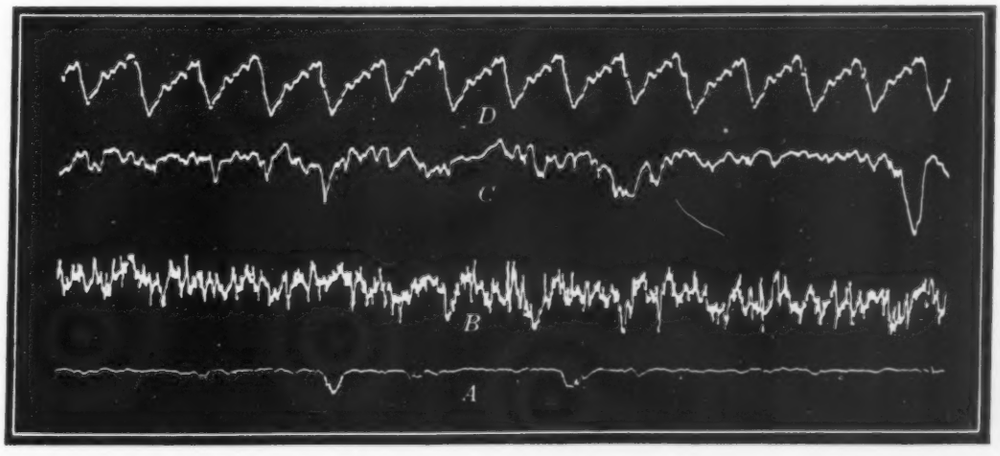
Measurements show that profiles of various machined finishes vary widely, not only in size of irregularities, but also in character. Some surfaces are regular while many are ragged; some are straight except for small tool marks, while others are decidedly wavy; peaks and valleys of about equal prominence characterize some finishes, while others have none. Typical records are shown herewith. The heights of the irregularities vary from 10 to 20 millionths of an inch on parts such as finely finished piston pins and well-honed cylinders, to several hundred times these amounts on roughing operations.

Inspection of the records proves that a single number is not a sufficient specification for the roughness of a surface. Differences in character must be taken into account. This is done by dividing the profile into three parts, the upper or peak section, the middle or medial section, and lower or valley section. A three-number specification, giving the depth of each of these sections of the profile in inches, furnishes a practical means by which a designer can specify the finish of a given surface.

### Measurements Effect Production Changes

Two steps have been taken in reducing roughness specification to practice. A means of measurement and a means of specification have been devised. These are proving valuable and some large changes in production have resulted from measurements taken thus far. Two steps, however, remain before the development is complete. Means must be provided for rapid measurement on production, and tests must be made to determine the relation between the smoothness of a surface and its suitability for the purpose for which it is designed; that is, the relation between roughness and fit, wear, lubrication, etc.

Articles on this and allied subjects published previously in MACHINE DESIGN are included in the list on page 25, March issue.




*Records made by the profilograph of surface finishes. A is lapped steel, 2000 X; B ground, 1000 X; C finish mill, 500 X; D diamond bored, 1000 X. The profilograms are made with a much smaller horizontal scale than vertical, irregularities therefore appear many times as sharp as they actually are*

# Are Piece Rates Practicable in Design Work?

By Carl Morey

IN THE midst of industrial achievement and the revolutionary changes that have taken place to reduce production costs in manufacturing, systems of operation in design departments have stood still for several decades. What few attempts at change have been made have increased engineering costs rather than reduced them, by the introduction of additional red tape. Today the designer has the same status as in 1800, and is treated as a temperamental individual who must be given his own time to rearrange various groups of the basic mechanical movements.

It seems reasonable to assume that the time element can be introduced in establishing engineering costs, and by careful analysis of the various factors involved and the application of established labor policies, changes can be wrought that will be beneficial both to employer and employe.

### Must Understand Factors

In attacking a problem of this nature, a thorough understanding of existing conditions and the various factors contributing to these conditions must be considered.

As a general rule the average engineer, particularly the designer, is inherently a poor showman, and through more or less constant association with men of the same type he becomes more unobtrusive. His work is usually isolated, that is to say, his time is devoted to study and concentration on the immediate problem, and he is oblivious to his surroundings. In addition, he is usually an indifferent salesman in-so-far as his services are concerned.

More often than not, the designer's income is insufficient to provide the necessary surplus of capital to carry him over a prolonged layoff, and this fact, in conjunction with his diffidence, tends to make him averse to seeking employment elsewhere. He therefore becomes stagnant, with a consequent lowering of working efficiency due to unexpressed dissatisfaction with his existing position. These conditions work to the disadvantage of both the employer and employe, and contribute to the high cost of engineering, particularly in the design department.

Another thing that deserves consideration is the fact that often a designer is assigned work for which he is not particularly adapted. This is more pronounced in plants building a variety of equipment. The designer, of course, accepts the assignment without question, but it is obvious that he executes the work at low efficiency.

### Aggressive Designer a Better Salesman

As a general rule, the occasional agressive designer who pushes himself to the front is the least qualified, technically, for advancement. He is a better salesman than designer, and should be identified with the sales end of the business. Many employers recognize this fact, and frequent shifts are made, to the advantage of both the engineering and sales.

It is generally conceded by executives of engineering departments that a man at fifty years of age has passed the peak of usefulness, and a designer at that age seeking a position is compelled to accept a salary penalty. This is as

| | | | | | |
|---|---|---|---|---|---|
| | 337-XP. (Schedule and Job Order No.) | | | | |
| 352 (Check No.) | Bennett, John. (Name) | | | | 6.00 (Pay Rate) |
| Roller (Name of Part) | | | | | Idler Gear (Operation) |
| STOP 5.00 | 7/6/33 | | | 9.00 START | 1 (No. Pieces Worked On) |
| | | | | | (Operation No.) |
| | Hours | Tenths | $ | Cents | |
| REGULAR | 7 | | 6 | 00 | FINISHED [X] |
| EXTRA | | | | | NOT FINISHED [ ] |
| TOTAL | 7 | | 6 | 00 | T. S. Brown. (Supervisor) |

*Daily time cards assist in the establishment of piece work rates for design activity*

wrong as can be, for the average designer cannot accumulate sufficient experience at much under fifty years of age to be really valuable. While he may be "full of ideas" at the age of thirty, he has not secured sufficient background for sound thinking.

An executive to supervise a department composed of such a wide variation of temperament should not only be an engineer but a psychoanalyst with an abnormal sense of justice. Inasmuch as it would be discouraging to attempt to find such a man, it seems logical that the problem could be attacked from a different angle with some decree of success.

### Numerous Attempts Failed

While various "systems" have been tried out with the object of eliminating some or all of the objectionable features, they have had but little real success. In fact, so little improvement has been experienced that they were discarded soon after adoption. Numerous attempts have been made to introduce the piece rate system in the design department, but the results of these ventures have been discouraging. Why?

First, the designer did not relish being removed from the temperamental class. He labored under an intangible policy he was pleased to call "the honor of the profession." He refused to be classed as a production unit. Often, the executive had no previous experience in rate setting and based his rates on rough guesses of existing costs; frequently he learned by experience that his rates were too liberal, as tracers and detailers increased their earnings to unprecedented figures.

Then, drastic cuts in rates and the resulting reduction in earnings of the men would stimulate them to still higher production sacrificing quality of product. Consequently, agreed on the part of the employer and employe caused the structure to topple into the discard.

Up to twenty-five years ago the drawing room was composed largely of men who had served apprenticeship in either the shop or drawing room. Today the detailing division is composed of men promoted from the tracing department, shop apprentice course, and some college men, but the designing division includes men who have reached that department by all the devious routes, with the college graduate predominating.

### Present Personnel More Approachable

All of these men have reached their positions in a much shorter space of time than formerly, and are therefore more approachable with any scheme that will benefit them.

During recent years employers have been compelled to accept so many revolutionary ideas, and so many of these radical schemes have proved profitable, that they are not averse to considering seriously or even attempting to install a revolutionary drawing room system. Therefore, the two most important obstacles standing in the way of the piece rate system have been removed.

### Rate Setting Is Difficult

The next objection is that of rate setting. Off hand, it would seem extremely difficult for an executive to determine rates for designing, detailing and tracing with any degree of accuracy without some precedent. An analysis of the problem is enlightening. Since it will be acknowledged that this work would be most difficult in a large job shop where one unit is built to one set of designs, this type of job will be the one under consideration.

As all of these special machines are built on contract, a contract price must accompany specifications in the quotation.

First of all in arriving at this contract price is the engineering cost. The average plant has a flat hourly rate for the drawing room to cover labor, supervision, factory overhead and materials. The executives get together and estimate the total number of hours to complete the job. The drafting is divided into designing, detailing and checking only, since little work is being traced on cloth at the present time, and is ultimately specified in terms of individuals. Drafting allowance is based on the executives' knowledge of the individual designer's ability, and the time required for him to complete the designs. Since a blanket profit is added after the costs are determined, is it not possible and practical to pay a designer on the same basis? Should he run over the estimate, it means no additional cost to the employer, while a reduction in time increases the earning power of the designer.

### Psychological Effect Valuable

The psychological effect on the designer contributes to better work, since he is largely his own boss and has the incentive to produce at a higher rate.

It is argued that the piece rate system would result in inferior work such as poor execution, more mistakes, etc. If a designer were required to correct his own errors on his own time however, he would studiously avoid making them, and if the design failed to meet specifications it would be a simple matter to track down the individual responsible.

In assigning work the executive will soon learn how the various men respond to different classes of work, and with this knowledge he can place the work to the best advantage. It then follows that the individual designer will be judged solely on the merits of his work, and his

(*Concluded on Page* 68)

# Graphs Facilitate Solution of Spring Problems

By John S. Carpenter

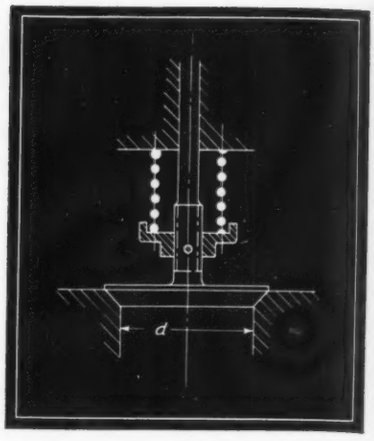



*Fig. 1—Suction valve of pump provides simple instance on which spring calculations are based*

TOO often spring problems are handed to the spring manufacturer after all machine details are completed and production has begun. The solution is then made doubly difficult, and frequently a compromise in spring action must be accepted on account of various limitations that could have been avoided if spring design had gone hand-in-hand with the development as a whole. The designer of the machine knows, or should know, just what spring action is needed and is far better acquainted with the requirements to be met than the spring manufacturer, who gets the data second hand and not always with a clear idea of the governing factors. Therefore, a better knowledge of spring mechanics would be of benefit to many designers.

Many years experience convinces one that the deflection characteristics of springs are not as well understood as are the loading characteristics. This is largely because the problem cannot be visualized mathematically as well as it can by graphics. Another fact is that the scale of the spring, that is, the load required to deflect one inch, is seldom determined correctly without a diagram of the spring action.

Almost every spring must have some degree of initial loading prior to the beginning of action in a given mechanism. For example, an automobile spring must support its share of the dead load in an acceptable position. The deflection due to initial loading is, in general, a secondary consideration as compared with the deflection due to live load, arising from whatever cause. The first can be taken care of by the free length and the number of coils, or by the curvature of the spring leaves in the unloaded conditions to be met. The second condition must be more carefully investigated, however for it really determines the spring scale. This is because the distance or angle between initial and final positions is more or less rigidly governed by such factors as stroke, clearances, allowable specific pressures, etc.

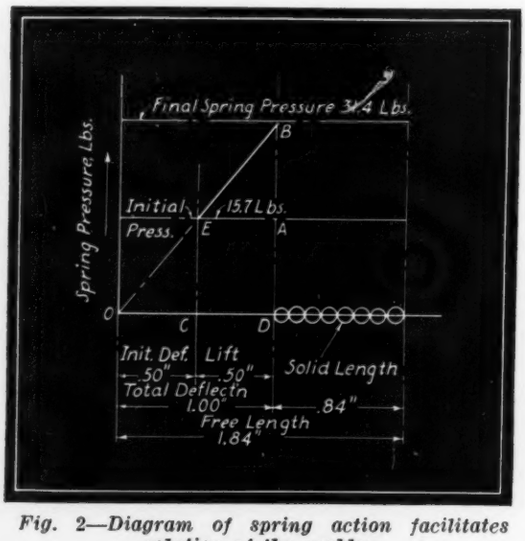



*Fig. 2—Diagram of spring action facilitates solution of the problem*

### Simple Case Cited

The spring on a suction valve of a pump provides a simple and instructive case of initial and final states and shows how outside factors may govern the design. Atmospheric pressure, which must open the valve, is only some 14.7 pounds per square inch in the static state. Liquid friction due to contorted passages and the necessary velocity head may reduce the effective pressure down to perhaps 10 pounds per square inch, based on the net diameter *d, Fig.* 1, so the total spring pressure per square inch of area cannot exceed some such figure in the wide open state. This maximum allowable pressure varies from case to case, depending on the size and type of valve, and what per cent the valve area bears to the area at *d, Fig.* 1.

In the type of valve shown, the lift, or upward

stroke, is often made half the radius of $d$ to get as much area through the valve as is represented by the diameter $d$. The initial spring pressure must now be decided. It cannot be zero on account of leakage. Assume that 5 pounds per square inch will be enough, which, for a 2 inch diameter $d$, a lift of 0.5 inch, and a final pressure of 10 pounds per square inch, will determine the complete spring characteristics, *Fig.* 2. The initial and final spring loads are thus 15.7 and 31.4 pounds respectively. Thus we see that the spring scale is determined by the difference between final and initial pressures divided by the lift, which is 31.4 pounds per inch of deflection. We do not particularly care what the initial deflection will be, as long as it is not excessive, but our spring design is fixed by the quantities we have chosen which gives us the characteristics $EB$ of the springs.

### Limits Are Imposed

Constructional reasons make a 1 inch O.D. of spring desirable. One of the many excellent spring tables gives, for steel springs, a load of 30.5 pounds at 60,000 pounds stress, and 0.393 inches deflection per 100 pounds load per coil, at 12,000,000 pounds torsional modulus, with a spring wire of No. 12 gage (0.105 inch). Research indicates that a torsional modulus of 10,500,000 is more nearly correct for this type of helical spring, so the deflection per 100 pounds per coil will then be in the proportion of 12/10.5, or 0.449 inches. Likewise the new stress at a loading of 31.4 pounds will be in the proportion of 31.4/30.5 or 61,750 pounds. The deflection per coil at 31.4 pounds load will then be 31.4/100 $\times$ 0.449 or 0.141 inches. So, for 1 inch deflection we require 1/0.141 or 7 active coils. The deflection being 0.141 per coil, the free pitch must then be equal to the diameter of the wire plus the deflection per coil or 0.246 inch. For squared and ground ends it is usually sufficient to add 1½ turns more, making our spring 7 active plus 1½ dead turns or 8½ in all. When compressed solid, the length will be 8 $\times$ 0.105 or 0.84 inch, as shown in the diagram, *Fig.* 2.

Suppose, because of changed conditions due to various causes, it is found that the above spring was stretched to a free length of 50 per cent greater, and was found satisfactory for the new condition. This new condition is met with occasionally and the designer wishes to know what the new stresses and loads will be. *Fig.* 3 shows this. The new free length is 2.76 inches. As the solid length will remain the same, we can investigate the new characteristic $EB$ with the new assumed lift of 0.625 inch. Add to this the fact that in the fully compressed position at the end of the stroke the length was found to be 1.25 inches instead of 0.84 inch as before.

The new total deflection is 1.92 inches, spread over 7 active turns; giving 0.274 deflection per coil. The new stress will be proportional to 0.274/0.141 $\times$ 61,750 or 120,000 pounds per square inch and the maximum load when compressed solid is 0.274/0.141 $\times$ 31.4 or 61 pounds. The new condition of 1.25 inches overall length at the end of the stroke limits the total deflection to 1.51 inches, so the maximum load exerted by the spring will be 1.51/1.92 $\times$ 61 pounds or 48 pounds, at a stress of 1.51/1.92 $\times$ 120,000 or 94,300 pounds per square inch and all this new condition proceeds on the basis of the same spring scale as before, viz., 31.4 pounds per inch. It is hoped that this seemingly overdrawn condition will give a better insight into the characteristics of springs, showing the importance of the diagram when selecting springs.

The elastic theory of springs indicates that the inside surfaces of helically coiled springs are higher stressed than the outside, and test experience with governor springs of small outside diameter but large wire diameter shows that failure starts on the surfaces of the inside diameter of the turns. Common spring formulas neglect the effect of shear, which becomes of rapidly increasing proportions as the ratio of wire to coil diameters increase. Good practice dictates mean diameters of coil 5 to 6 times the size of the wire, resulting in longer lived springs than those made smaller, and, within reason, anything up to 10 times is still better.

Articles on this and related subjects published in previous issues of MACHINE DESIGN include:

"Adjustments in Automatic Machines Test Skill of Designers," by L. E. Jermy, Sept., 1929, p. 9.

"General Considerations in Designing Mechanical Springs," by A. M. Wahl, May, 1930, p. 26, June, 1930, p. 34, July, 1930, p. 24, Aug., 1930, p. 44.

"Developing Springs Graphically," by M. G. Van Voorhis, April, 1931, p. 48.

"Spring Design Must Take Into Account Inactive Coils," by R. F. Vogt, Dec., 1932, p. 37.

"Designing Springs for Small Space," by John S. Carpenter, Feb., 1933, p. 39.

"Watch Independent Springing," Oct., 1933, p. 16.

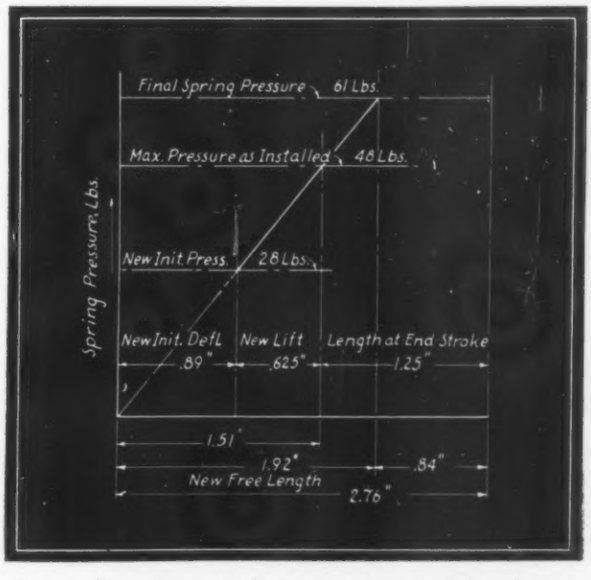



*Fig. 3—In some cases it is necessary to determine revised conditions of application*

# Engineers Look to Modern Home as Hope for Prosperity

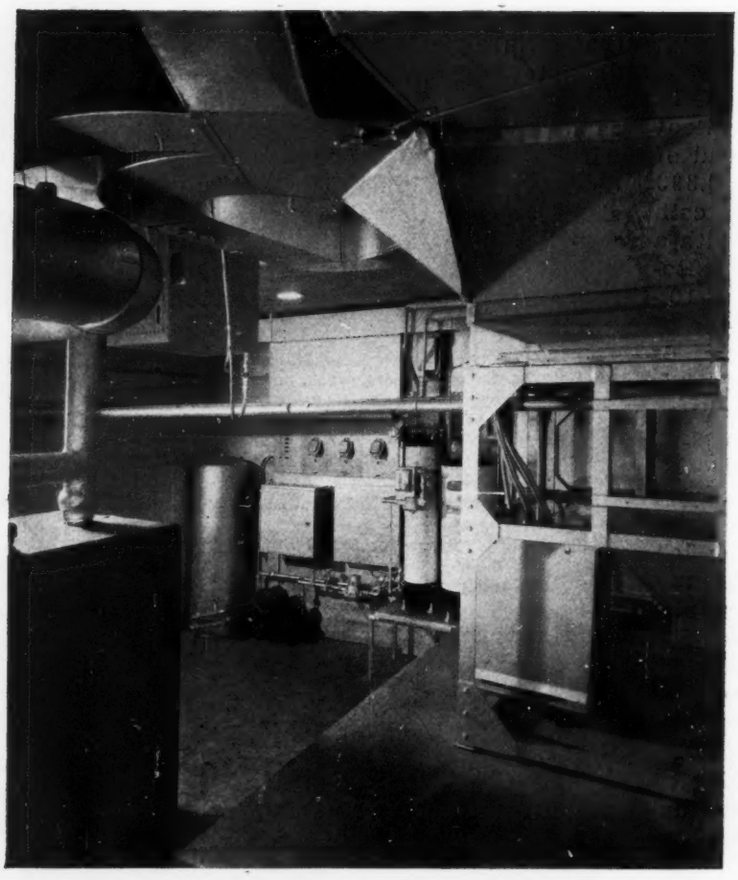


*Fig. 1—A weather room supplants the old familiar furnace room, providing completely automatic air conditioning throughout the house*

MECHANIZATION and electrification of the American home is the key to a new era. Virtually every line of manufacture, whether it be machine tools, fabricating equipment, materials or parts will share in the benefits of this new market. The heavier equipment industries that once looked to the automobile principally for the bulk of its business already is finding an important outlet for the production of items such as the domestic refrigerator, washing machine, sewing machine, air conditioning equipment etc.

Although electricity and mechanical equipment have had a place in the home for a number of years, one of the greatest advances in the evolutionary process came with the introduction of the steel house. This type of home was much in the limelight until the depression retarded development. Now it is again in the eye and various plans submitted to the public show that much thought has been given to it over the past two years. In the Dec., 1932, issue of MACHINE DESIGN, attention was called to the tremendous potentialities of the modern home as a ready market for new machines and methods.

The answer to the question: "What is ahead for the home owner?" definitely rests with the engineer who continues to come more and more into the picture, particularly as the emancipator of the housewife. With new mechanical devices he is investing our domestic environment with increased comfort and convenience. Much of what lies ahead is capably portrayed by the new Westinghouse home opened recently at Mansfield, O.

This is an eight-room dwelling that consumes 18,000 kilowatt hours annually, or about 30 times more than the average home. Nineteen built-in motors perform various household services. Complete air conditioning increases comfort; shadowless lighting relieves eye-strain. Decorative laminated molded material adds to the beauty of the interior.

In this ultra-modern residence the laundry no longer is a source of drudgery for the housewife. Efficiency has been the watchword in designing the equipment for these quarters, from three-unit washer to clothes dryer and ironer.

The clothes washer, *Fig.* 2, is the first of its

type developed. It is essentially three washers in one, formed into a "cloverleaf" unit with a centrifugal extractor in the center. This facilitates a continuous washing process; washing, rinsing, blueing and wringing can be carried on in sequence.

Another department of the house reflecting the machine age is the kitchen. The main center lighting fixture is hung from a grill connected with the ventilating system, employed to take warm air from the ceiling. The refrigeration unit also is connected with this system to remove warm air. A lever over the kitchen sink opens this ventilating system and automatically starts a fan over the window. The exhaust fan discharges all warm air disagreeable odors from the kitchen. Foodmixers and similar equipment are installed permanently. The influence of the automobile assembly line with its feeder arteries is seen in this kitchen layout. From the time all food is delivered until it is cooked and ready to serve, the process of food preparation fall into a natural, efficient system so that steps are saved and mental fatigue avoided.

### Unit Is Completely Automatic

The dishwasher sink is completely automatic. An electric switch is turned on to fill the dishwater. During this process the dishes are sprayed and washed. The drain opens automatically. When all the water is out of the unit, the drain closes and hot rinsing water is introduced, spraying and splashing the dishes as when washing. The drain opens again, and after sufficient time has elapsed for the water to leave the machine, the lid is opened automatically. The impeller now acts as a fan to dry the dishes before the motor shuts off.

Instead of a furnace room in the basement there is a weather room, *Fig.* 1. Temperature, humidity, etc. is selected and maintained automatically by a system of thermostats and switches to make the home completely air conditioned. An oil burner and a boiler supply steam for heating coils. A fan forces air over the warm coils and conducts it through a duct system to the various rooms of the house. If the water level in the boiler drops too low or the steam pressure rises too high, the oil burner is shut off automatically. The cooling coil section for summer is a part of the unit that is used for warming and humidifying in winter.

Although experimental, the Westinghouse residence reveals a trend and stands as a striking example of what can be attained mechanically and electrically to make the home a better place in which to live.

*Fig. 2—Three-unit type washer expedites laundry operations by permitting work to be carried on in a continuous process*

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## Critic of the Machine Age Writes New Book

WRITINGS of Stuart Chase are like a shot in the arm . . . stimulating but not necessarily a permanent relief. Consequently every so often he produces a new volume to follow up a previous prescription. This time it is *"The Economy of Abundance,"* in which he draws plans for a new and more desirable world.

Though we might label Chase as the popular type of economist, there is something about his writings that appeals. He may lack the ability of setting forth definite solutions to economic problems that confront us, but he nevertheless gives his readers much to think about.

The book is built on his own findings as well as on those of other students of our perplexed civilizations. He dramatizes the wastes of competition, problems of overcapacity, unemployment, etc. With no less zest he reveals the marvels of mechanization, most of which have been discussed in these columns from time to time.

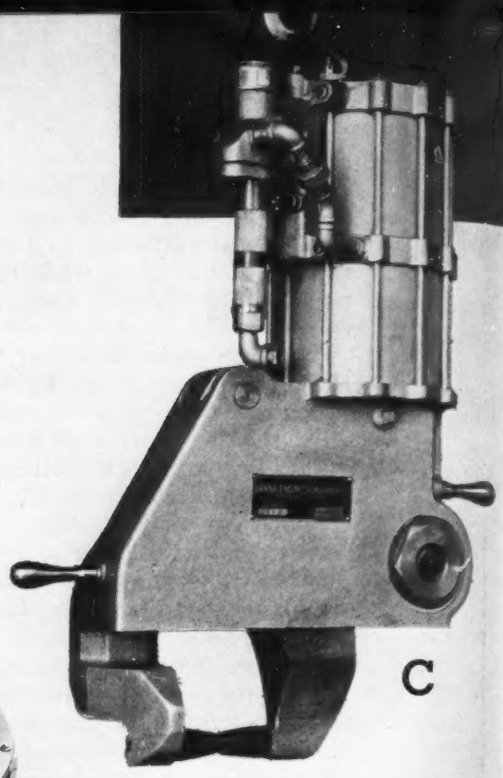
And then in the final chapter he sets forth in eighteen separate items his conception of what an abundance economy demands. These are interesting indeed but in many cases they lack conclusive evidence as to just how they can be best met. Most of the needs cited are common knowledge to everyone; for example, he recommends the elimination of waste, conservation of natural resources, shorter working hours and so forth. Who does not know that something must be accomplished in this direction? What we have most needed is for someone to study and advise as to how a planned economy can be carried out effectively to restore balance and prosperity.

This discussion is not intended to deride the efforts of Mr. Chase. His study, while he leaves much to the judgment of the readers, has an exhilarating effect.

Macmillan Co., New York, is the publisher. It may be obtained through MACHINE DESIGN for $2.50 plus 15 cents postage.

# Design Features in New Machines

**A Pictorial Presentation of Recent Machinery from the Standpoint of Design.**



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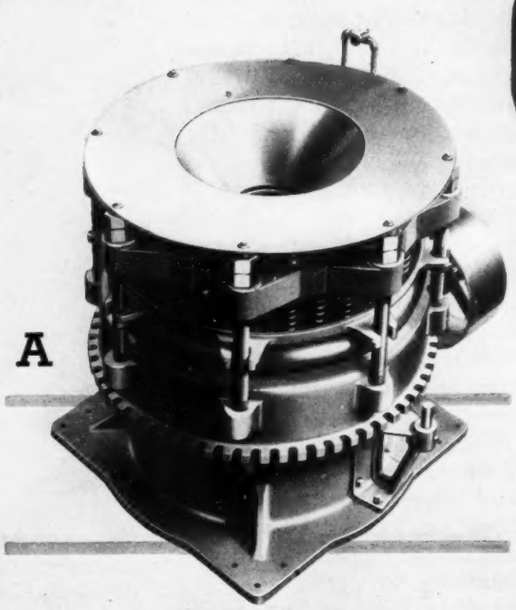

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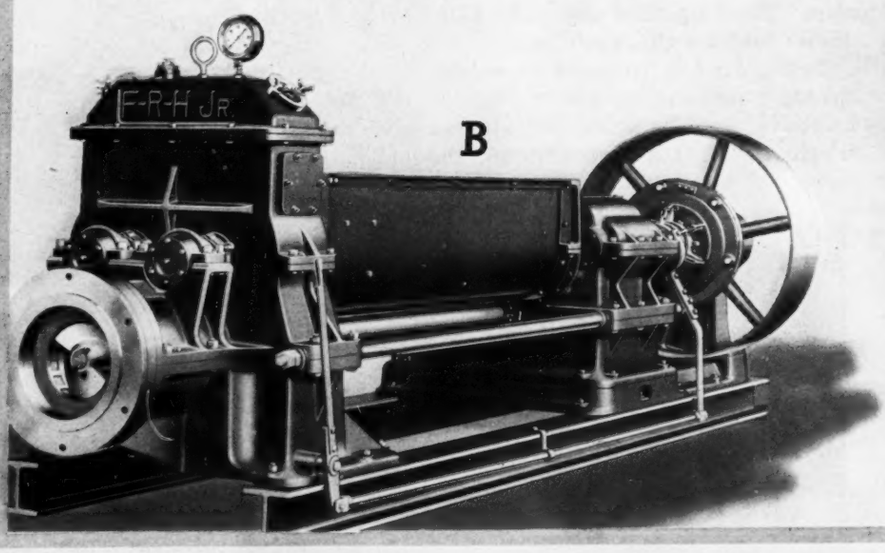



B

(A) Unique crushing action is obtained in the Telsmith Gyrasphere of Smith Engineering Works, the head being impelled both by a gyrated shaft and a cam action. Springs relieve momentary packing and compensate for uncrushable material in the crushing chamber. Crushing members are of manganese steel.

(B) De-airing combination brick and tile machine is built to hold a perfect seal so that a high vacuum results. All bearings are equipped with pressure-gun fittings while the packing glands are unusually long and are equipped with grease lanterns. Shaft thrusts are taken by roller bearings. Fate-Root-Heath Co. is the manufacturer.

(C) Roller and toggle mechanism, entirely enclosed, is used to transmit the power movement of the cylinder-piston unit to the die in such a manner that the latter is closed upon the rivet with a minimum of power consumption in the squeeze riveter manufactured by Hanna Engineering Works.

(D) Built-in motor mounted at the top rear of the column on the Automatic Machine Co. profile milling machine drives the vertical power shaft to which a V-belt drive pulley for the spindles is attached. A worm gear drives the horizontal control shaft through a clutch actuated by a solenoid. At the completion of the cycle a limit switch operates the solenoid, disengages the clutch and stops the operation.

(E) Designed especially for handling exceptionally large dies into and out of the press, the new tiering truck of Elwell-Parker Electric Co. is equipped with three electric motors, the drive motor, hoist motor and die pulling motor, each with its individual controller. The die pulling device consists of a heavy shaft driven by a chain from a combination worm and spur gear reduction.

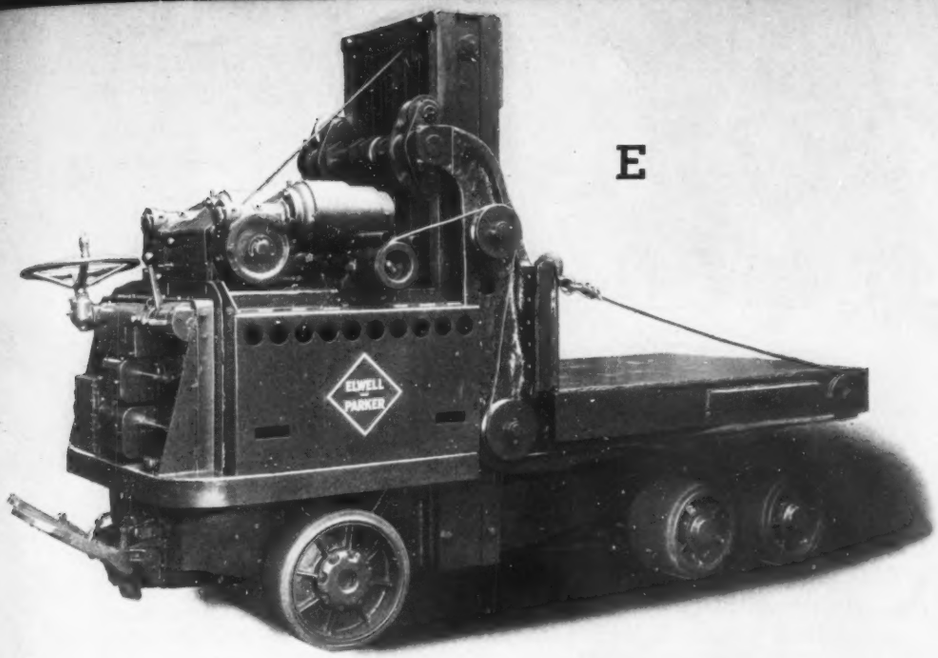
(F) Two motors that start and stop together, both operated from the same switch, are employed on the Hacker Mfg. Co. block leveller which has been materially improved in appearance. A motor mounted at the rear drives the cutter through a V-belt, while another motor within the pedestal drives the work table through a speed reducing unit. Sawdust is drawn through passages in the arm and the post to a separator on the rear door.

(G) Indicative of the trend in design, the conventional model General Electric refrigerator is distinguished by simplicity of line and compactness of form. The legless feature of the case, designed by Henry Dreyfuss, adds to its appearance. The motor has been transferred from the top to inside the bottom panel in this model. Freezing chambers are of stainless steel.

(H) Electric sanding or grinding portable machine introduced by Buckeye Portable Tool Co. is powered by a high frequency motor built into the machine. An effective ventilating system adds to the ease of operation because it prevents the exhaust from blowing in the face of the operator, while dust is blown away.

(J) Ease of handling in restricted areas is accomplished in the design of the new portable warp tying machine for silk and rayon of Barber-Colman Co. by employment of ball bearing rubber tired wheels and extensive use of aluminum castings. A redesigned knotter mechanism will handle the fine threads of silk and coarser cotton thre

(K) Entire respon plete machi equipment is taken manufacturer of t which combines pres and delivery, motor accessories into a Special high speed b ings are employed. for the motor drive

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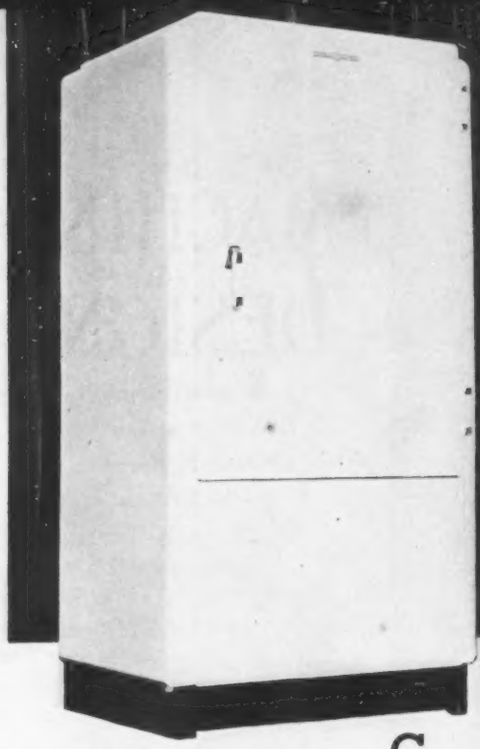

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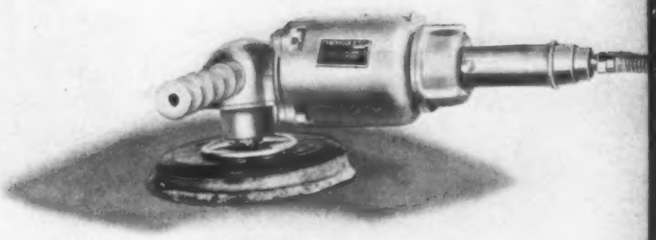

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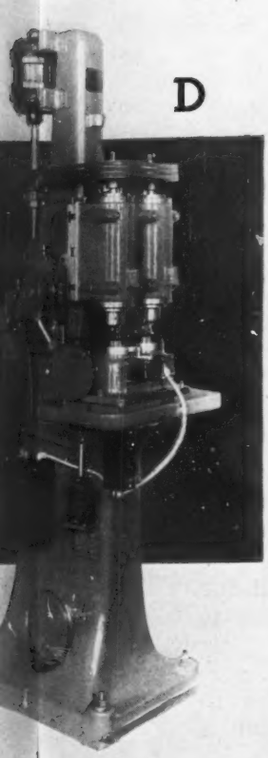

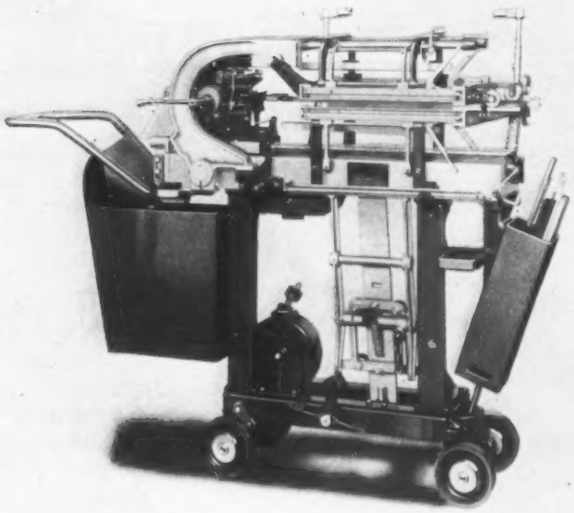

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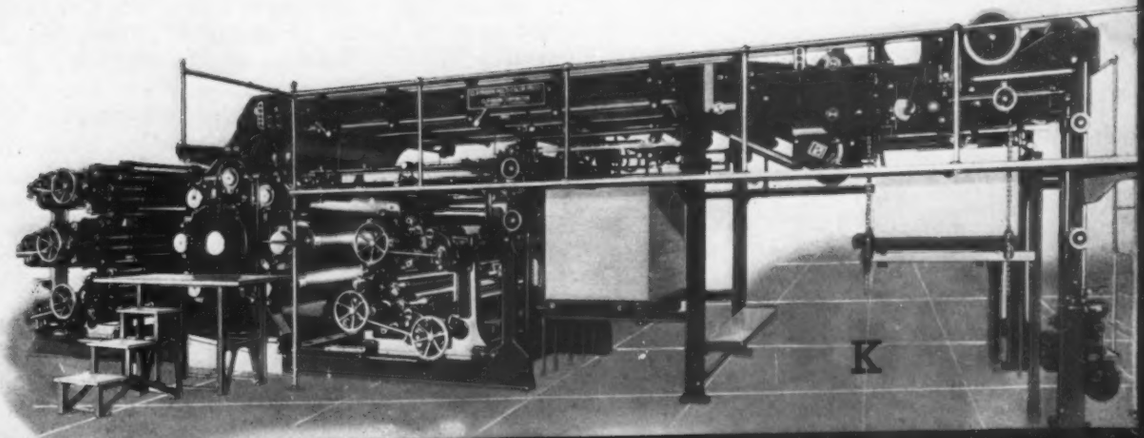


K

reads of silk and rayon as well as arser cotton threads.

K) Entire responsibility for the complete machine and auxiliary uipment is taken by Claybourn Corp., anufacturer of this five-color press hich combines press, automatic feeder d delivery, motor and control, and all cessories into a composite unit. ecial high speed bronze cylinder bear- gs are employed. Silent chain is used r the motor drive.

# MACHINE DESIGN

L. E. JERMY, EDITOR
ALLEN F. CLARK
HAROLD B. VEITH
F. H. BURGESS

## Broader Aspects of Chief Engineers' Work Cover Research, Development

NOT all companies are in position to establish research departments—either to assist in creating new products or to develop existing lines. Reliance instead is placed on reports of service men, salesmen and others who are able to contact the field. In too few cases are chief engineers and designers given the opportunity to undertake this responsibility or to share in it to any extent, even though they often are best fitted to analyze the requirements of the market from the machine standpoint.

An alternative method has been set up by a valve manufacturer, as discussed in an article in *Executive Service Bulletin*, that has distinct possibilities. A committee has been formed representing the engineering, production, sales, advertising and financial departments of the company. This committee meets at least once a month. Since its inauguration rapid progress has been made by the company and sales have multiplied.

Most engineering companies have meetings of executives representing various departments, sometimes weekly. These meetings are not, however, strictly of a research or development character, and this angle is apt to be overwhelmed by discussions of engineering and sales of existing products.

It is at meetings devoted specifically to extending the market that the chief engineer's advice should be invaluable. Those best fitted by character, training and observation to lead these discussions are enviably placed.

• • •

## Best Is Not Costliest!

ARE we due for an era of "gadgeted" machinery? Or will simplicity be the keynote for some time? Ordinarily, with better business conditions the tendency is to load machines with more or less superfluous devices calculated to serve as selling assets. To some extent this holds true at present, but the trend appears more definitely to be set in the other direction—the use only of the most essential supplementary equipment.

As pertinent examples one of the General Motors' lines might be cited as well as the products of several of the leading refrigerator manufacturers. Instead of turning out de luxe models only, less elaborate and less costly models are being produced.

Prosperity, undoubtedly would effect a change in purchasing psychology, but the time has not yet come to concentrate on design of equipment made expensive by over-abundant use of frills. Unusual yet sound construction and employment of established materials and parts still appeals in mass buying.

# PROFESSIONAL VIEWPOINTS

*Machine Design Welcomes Letters Suitable for Publication*

## Design Features in New Machines

*To the Editor:*

I WISH to register my approval of the new feature included in your April issue, namely, the double page of pictures of machines. Everyone who is interested in the design or manufacture of machinery is interested in knowing more about the machines that are actually being built by manufacturers at the present time.

In this initial page of pictures one is struck with the fact that rolled steel is being used to a great extent in this group of machines, although the vertical turret lathe is a good example of cast construction.

This kind of authentic information is valuable to everyone interested in machinery. It is all very well for various schools of thought in design and manufacture to claim that their particular ideas are being universally accepted, but it is far more important to have a disinterested organization select groups of actual machines and present the facts about them. Such facts give all of us a reference point in determining what has been accomplished.

—ROBERT E. KINKEAD, *President,*
Robert E. Kinkead Inc.

## Proper Appreciation of Engineering

*To the Editor:*

YOUR editorial on this subject in the April issue mentions the low pay of engineers, and suggests that this is because of an overproduction of engineers. I am quite confident that there is an overproduction of engineering graduates, but I want to call attention to another reason for the low pay of the ordinary engineer. Engineering graduates do not usually complete their training. The reason for this failure may be seen from the following quotation from a letter written by a senior at an engineering college.

"The engineering graduate of today is willing to consider any position because he realizes his own limitations . . . . He lacks actual contact with business and with industry itself. He believes . . . . he can find these important things in almost any position which he may accept."

Some find the way to responsible engineering positions by this route. Some use this route to other responsible positions that have nothing to do with engineering. But when they succeed in either of these two ways it is the result of either superior ability or chance. There is no reason why such hit or miss methods should produce good results, and in examining applicants for work I have seen too much evidence that they do not. I have seen too many young men who took the wrong job at graduation, and who even in 1929 realized that they were not getting anywhere and were trying to make a new start. Such a person may realize the low pay of his group and blame an excess of engineers, when in fact the blame should be laid on the fact that he has not completed his education and cannot therefore step out of the low grade engineering job.

The fact is that an engineering school does not complete the education for engineering positions. The school gives a basis of mathematics and a general survey of the field. But the remaining part of the education, which must be taken in industry, should be considered with just as much care as the school itself. To start an engineering education without counting the hardships after graduation as well as the cost in the school is folly.

—A. W. FORBES, *President,*
Forbes & Myers

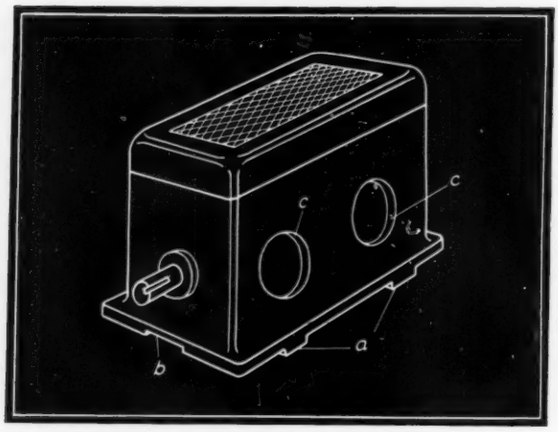
## Consider the Human Element!

*To the Editor:*

REFERRING to the interesting article on the consideration of the human element in the design of machinery published in your March issue, there are a number of interesting points in the design of engine frames and covers which might be of interest. Most of these engines have sheet metal covers over the valve gear on top, as shown in the accompanying illustration, and as an electric light usually is installed over

the engine, many covers are damaged by operators who stand on them to replace bulbs. It is distressing to go into the field and find your well-dressed engine with its derby dented in. For this reason some designers have stamped corrugations in the top of the hood. Others, wishing to save die costs, have used rolled steel floor plate with non-skid impression to make a tread.

Lugs like *a*, used to save machining on bases, are very unpopular with installation men as they interfere with the use of rollers in moving the machines. A slot *b* at the end is a good addition




*Conditions of use govern to a large extent features to be included in design*

so that a pinch bar can be inserted under a machine to lift it for inserting rollers. Such a slot is often requested and sometimes demanded.

In addition to these provisions for handling, adequate and obvious taps for eye bolts should be provided in the top of the machine for crane lifting. If this is not done, it is common for riggers to remove the covers *c* and pass hemp slings through the machine. Surprising quantities of hemp fiber are stripped off and find their way to the strainers of the forced lubricating system, causing a shut-down if not worse damage.

—H. B. DEXTER

## Protect Your Patent Rights!

*To the Editor:*

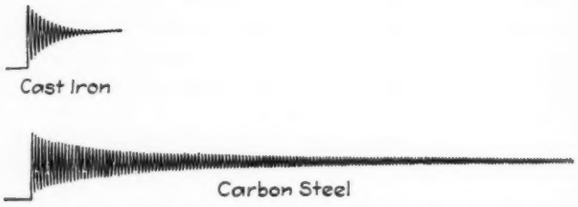
I HAVE been quite interested in reading your various articles on patents, and would appreciate it very much if you could mail me the April article entitled "Patent Contracts Insure Legal Protection" along with the other articles mentioned on page 61. It is my desire to have these articles kept on file in a folder which can be referred to conveniently. Would it be asking too much if you would compile these articles for me in such a folder and make a charge covering expense?

—T. F. HAMMER, *Vice President,*
Malleable Iron Fittings Co.

## Cast Iron Dampens Efficiently

EXTENSIVE tests on the effect of cast iron cranks on bearings have shown that with proper finish the cast shaft is equal to or even slightly better than steel from a wearing point, according to Fred J. Walls who presented a paper on "Recent Engineering Developments in Gray Cast Iron," at a joint castings symposium held in Cleveland recently. The counterweights and cheeks of the crankshaft are cast to size and finish, thus making it economical from a machining standpoint. One important feature in favor of cast iron over steel is the damping effect.

In the *Symposium on Cast Iron* it is pointed out that, "damping capacity, only recently brought prominently to the attention of designing engineers, is defined as the amount of work dissipated into heat by a unit volume of the material during a completely reversed cycle of unit stress or, in other words, the ability to absorb or "Dampen" vibration. It is best determined by

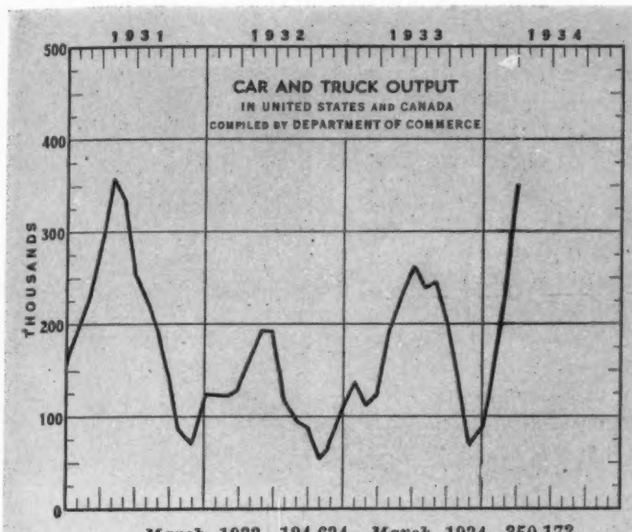



*Cast iron cranks demonstrate considerable dampening ability in extended tests*

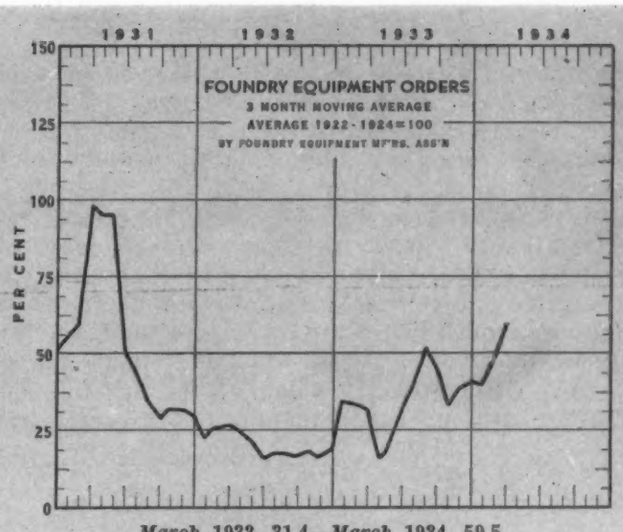
the Foeppl-Pertz damping tester which gives graphs such as shown in the accompanying illustration. These graphs show the relative duration of a vibratory torsional impulse imparted to a cast iron specimen and a steel specimen.

"The value of damping capacity in machines and machine tools is so obvious as to make discussion superfluous. It perhaps is not so commonly realized that the effective strength of a vibrating part may be much greater if made with a material of high damping capacity and only fair strength than if made of a much stronger material of low damping capacity—the latter allowing vibrations to build up to serious intensity while the former will "damp" them out. The acoustic properties are closely related to the damping capacity since the duration of sound from a vibrating body is that portion of the damping graph which registers on the ear."

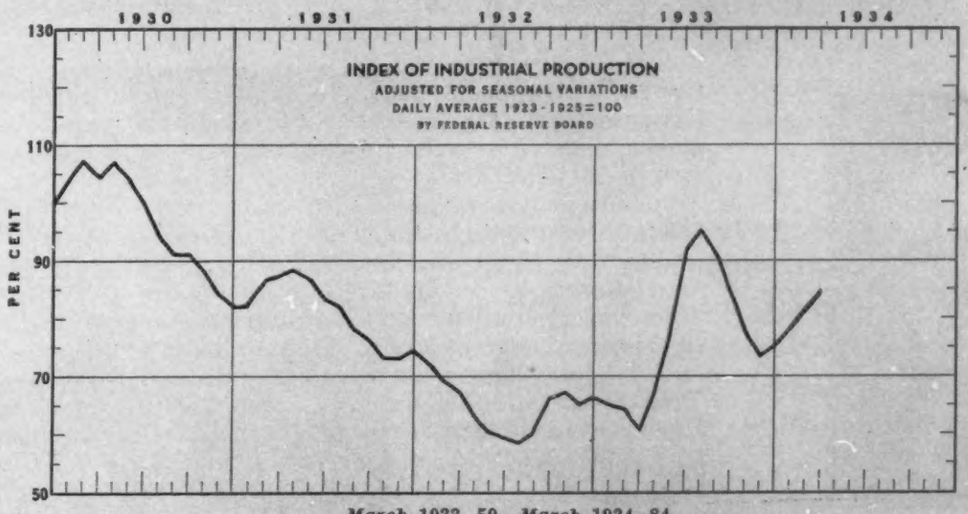
# How Is Business?



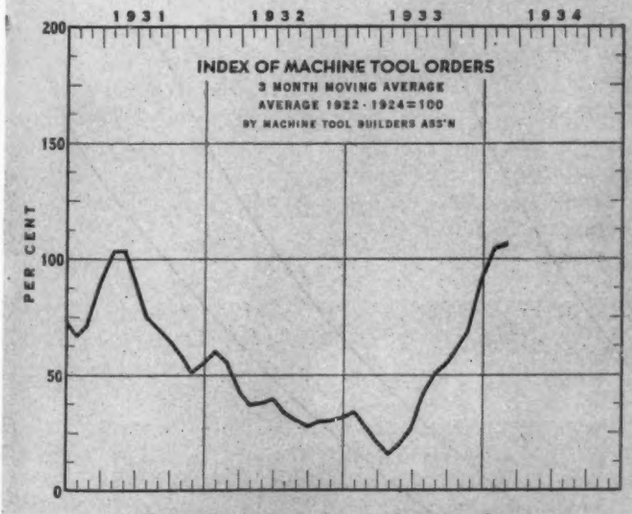

*March* 1933, 124,634—*March* 1934, 350,173




*March* 1933, 31.4—*March* 1934, 59.5




*March* 1933, 59—*March* 1934, 84

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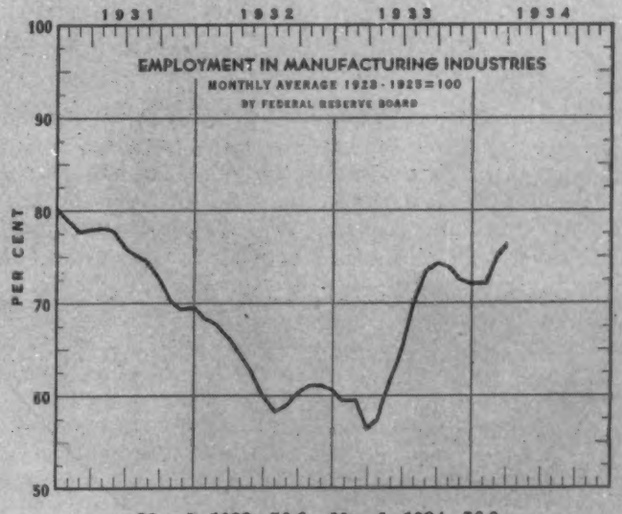


*March* 1933, 56.6—*March* 1934, 76.9

# MEN OF MACHINES

LEWIS B. STILLWELL

ANOTHER honor has been bestowed on Lewis B. Stillwell. He is the 1933 Lamme medalist. The award was made by the American Institute of Electrical Engineers for his distinguished record in design, installation and operation of electrical machinery.

This New York consulting engineer was born in Scranton, Pa., March 12, 1863. He holds degrees conferred by Lehigh University and Wesleyan university of Connecticut. Numbered among his earlier connections is that of chief electrical engineer of Westinghouse from 1891 to 1897. During the three following years he was in charge of electrical work at Niagara Falls.

Dr. Stillwell was a leader in the development of alternating current. His inventions include the Stillwell regulator.

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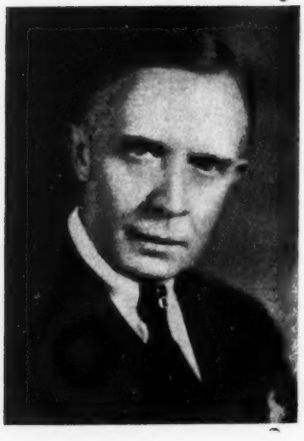


ARTHUR C. WILLARD

THE University of Illinois has chosen an engineer for its new president. He is Arthur Cutts Willard, whose engineering accomplishments have endowed him with an international reputation in the field of heating and ventilating.

Born in Washington, D. C., Aug. 12, 1878, Prof. Willard attended Central high school there. At Massachusetts Institute of Technology he received his bachelor of science degree in 1904. Immediately he began his teaching career in California and in 1906 was appointed assistant professor of mechanical engineering at George Washington university.

The president-elect came to the University of Illinois in 1913. Four years later he was made full professor and in 1920 was named head of the department of mechanical engineering.

• • •

R. E. W. HARRISON

EVIDENCE that engineering training is being recognized as a primary asset in certain governmental positions is found in the appointment of Robert E. W. Harrison as chief of the industrial machinery division, bureau of foreign and domestic commerce. This move places in a key position a well-qualified man. Mr. Harrison has a wide acquaintance among engineers and industralists on both sides of the Atlantic.

After extensive experience abroad, he assumed in 1926 the position of mechanical engineer with the Cincinnati Milling Machine Co. When Cincinnati Grinders, a subsidiary, was incorporated he became director and chief engineer, and later sales engineering director of both organizations.

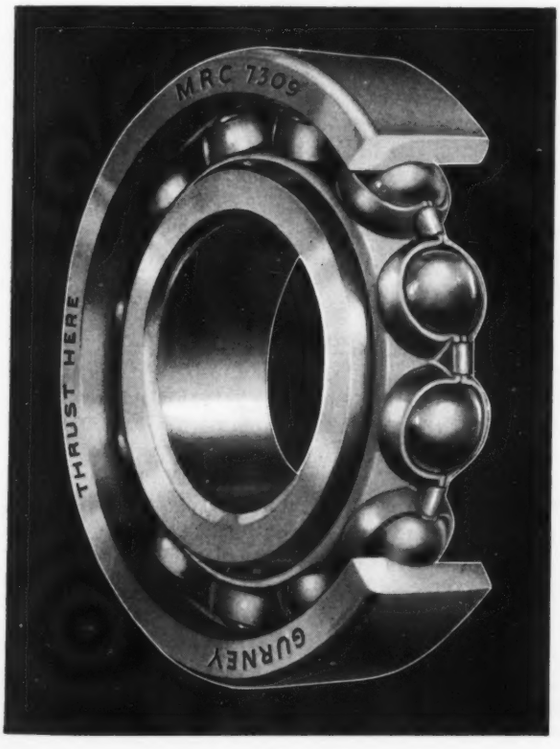
In 1932 Mr. Harrison established a consulting engineering

# M-R-C *Leadership*

## *What 89 years of Specialization can do for you ——*

### M-R-C Gurney Type Radio-Thrust Bearings

**This bearing was originated in 1909 by F. W. Gurney and designed to provide a single-row bearing capable of taking a heavy thrust load in addition to radial load. It is particularly recommended for use where: (a) the thrust load is extremely heavy; (b) where there is a combination of radial load with a heavy thrust load; (c) on vertical shafts.**




**M-R-C represents the combined experience of three pioneer Ball Bearing Manufacturers—**

**GURNEY . . . with 28 years**
**STROM . . . . with 20 years**
**SRB . . . . . with 36 years**

**—a record of experience unsurpassed by any other ball bearing manufacturer.**

**89 years of specialization in the manufacture and application of Ball Bearings to all types of industries, has filled our book of experience with invaluable data. You can apply this knowledge advantageously . . . just as hundreds of industrial leaders are doing . . . by letting M-R-C supervise your bearing designs.**

**MARLIN-ROCKWELL CORP.**
*Executive Offices:* JAMESTOWN, N. Y.
*Factories at:* Jamestown, N. Y.; Plainville, Conn.; Chicago, Ill.

*MANUFACTURERS OF*

**M-R-C BALL BEARINGS**
**GURNEY • SRB • STROM**

practice and was retained by many important concerns as a consultant on problems of design, management and marketing. His activities in the American Society of Mechanical Engineers of which he is a prominent member, includes that of secretary of the executive committee, machine shop practice division.

* * *

PROF. NEIL P. BAILEY of the mechanical engineering staff at the University of North Carolina has been appointed head and professor of the mechanical engineering department at Iowa State college. He replaces Prof. Warren H. Meeker who will retire as active head of the department but will continue as a full professor.

* * *

DONALD R. DOHNER, formerly director of art in the Westinghouse engineering department, and Alexander J. Kostellow, professor of industrial design, Carnegie Institute of Technology, have established offices in Pittsburgh to carry on an industrial design and research service.

* * *

R. H. ANDEREGG has been appointed vice president in charge of engineering of the Trane Co., LaCrosse, Wis. He has served the company as chief engineer.

* * *

DR. IRVING LANGMUIR, associate director of the General Electric research laboratory, recently received an appointment as honorary chancellor of Union college, Schenectady, N. Y.

* * *

R. M. SHERMAN, president of the Silent Glow Oil Burner Corp., Hartford, Conn., is the new president of the American Oil Burner association, having been elected to that office at the recent annual convention in Philadelphia.

* * *

LOUIS RUTHENBURG has been elected to the presidency of Servel Inc. He has had a varied experience in engineering work.

* * *

HOWARD DARRIN, European body design expert, is in South Bend, Ind. developing improvements for the new Studebaker.

* * *

WILBUR G. HUDSON has been appointed chief engineer of the Pershing road plant of the Link-Belt Co., Chicago.

* * *

GEORGE LINDGREN recently joined the engineering department of the Copeland Refrigeration Corp.

* * *

H. D. JAMES, control expert and long a consulting engineer for Westinghouse, has opened an engineering consulting service.

* * *

CHARLES R. NEESON, HARRY L. GALSON, HANS K. STEINFIELD and HENRY C. HELLER, four engineers of the Baldwin-Southwark Corp., Philadelphia, recently were awarded John Scott medals for their work in developing the De La Vergne air conditioner in 1933. In addition to medals the recipients each received $500.

* * *

RALPH SMILLIE now is engineer of design, Port of New York Authority, New York City.

* * *

ALMON L. BEALL recently was appointed engineer, engineering department of Wright Aeronautical Corp., Paterson, N. J.

* * *

OTTO MUELLER, stamping engineer, has been appointed head of the newly created engineering and research department at the frame plant of the Murray Corp. of America, Ecorse, Mich.

* * *

LIEUT. COMMANDER T. G. W. SETTLE has been ordered to China. This move is particularly significant inasmuch as Officer Settle has said that he would not be satisfied with his naval career until he achieved command of a warship.

* * *

C. E. SKINNER, assistant director of engineering of Westinghouse, has been elected a vice president of the American Association for the Advancement of Science, and chosen chairman of its section M (engineering).

* * *

PROF. MELVIN L. ENGER recently was named dean of the college of engineering and director of the engineering experiment station of the University of Illinois. His position as head of the department of theoretical and applied mechanics will be filled by PROF. FRED B. SEELY. PROF. O. A. LEUTWILER will head the department of mechanical engineering.

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## Obituaries

MAJOR William J. Hammer, distinguished engineer and one of the early associates of the late Thomas A. Edison, died recently. His war service included work at the United States patent office. While there he marked and held up certain patents likely to convey information to the enemy. An enthusiast in the science of aeronautics, Maj. Hammer became the owner of the first airplane ever sold in this country to an individual.

* * *

WILLIAM BANCROFT POTTER, long the engineer of General Electric's railway department and a veteran of electric traction work in this country, died recently. He held 130 patents for various inventions. In the early years of his career he devised a practical type of street car control which provided the underlying principle of most systems employed since.

* * *

FREDERICK A. GEIER, president of the Cincinnati Milling Machine Co. and one of the founders of the National Machine Tool Builders association, died recently at his home in Cincinnati.

# TOPICS

INTRICATE parts of a calculating machine, said to be the world's largest, were on display recently at the Moore school of electrical engineering of the University of Pennsylvania. I. A. Travis of the faculty will direct the assembling of the 75,000 parts on a steel foundation. The machine will be capable of solving problems far beyond the mathematical capacity of any human being, *New York Times* states.

Weighing three tons, it is said the instrument not only will solve various related mathematical equations but will "memorize" the results, solve other variables in the equations, reach back in its memory and give accurate answers tabulated and permanently recorded on paper.

* * *

**Proposed Device Will Register Radio Listeners' Sentiments**

THE day apparently is coming when the radio audience can be counted electrically. Dr. Nevil Monroe Hopkins, New York university electrical lecturer, is working on a device which he calls a system of "radio-voting." One idea involves the use of buttons installed on the radio set. By pressing the button corresponding to his sentiment regarding the program at a stated interval, the listener with others following the same procedure would be recorded instantly by increased current consumption at the power station furnishing the electricity. This information then would be relayed to the broadcasting station.

* * *

**American Railroads Increase Use of Aluminum Alloys**

A SURVEY recently completed reveals that railroads in this country have in operation more than 1000 cars in which aluminum alloys are employed. First car of this type was built in 1923 for the Illinois Central railroad, since which time there have been increasing efforts to lighten rolling stock. On the Long Island railroad is operated a double-deck passenger car that seats 120 persons instead of the usual 78 but through the use of aluminum in the body and underframe it weighs only 71,800 pounds, compared with an estimated weight of about 110,900 pounds that would have resulted had steel been used exclusively.

* * *

**Plywood, Sheathed with Metal Finds Place in Railroad Cars**

DESPITE the fact that steel has supplanted wood to a large degree in the manufacture of many products, the use of a combination of these two materials has been found desirable in instances where light weight, strength and stiffness are important. One of its latest adaptations is in the construction of the body of the "Railcarbus" built for operation on the Hillsboro & North Eastern railroad in Wisconsin. The material consists of a three-ply section of yellow poplar, sheathed with metal, usually steel, on one side or both. Between the steel and the wood is a cotton fabric bond.

* * *

IN THE news during the past month was a new electrodeposition process, making possible thick nickel finish of great brilliance through a highly efficient and stable electrolyte. Subsequent polishing or color-buffing are said to be unnecessary.

* * *

The new streamlined train of stainless steel completed for the Chicago, Burlington & Quincy railroad embodies a framework or skeleton utilizing the latticed method of construction with parts secured by electric welding rather than riveting.

* * *

Brick machine wear plates of alloy cast iron containing 2 per cent nickel and 0.75 per cent chromium have delivered 150,000 bricks and still remain in service.

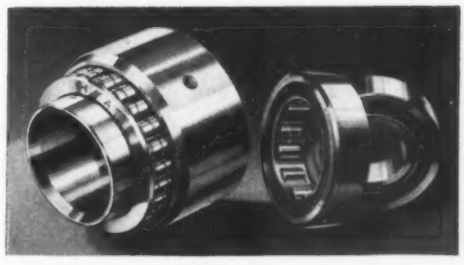
# YOU CAN CLASS THE VISITS OF HYATT SALES ENGINEERS AS—

## "Designing Time"

IF YOU COULD visit us and witness the actual "designing time" we put into Hyatt product and plant equipment engineering you would realize we speak from experience.

When we say engineers are busy men, we know, and we further know the kind of service they welcome. Hence, fully appreciative of the value of your "designing time," our men help you conserve it.

Coming to you, not with self-interest alone, but as assistants to you in your bearing application problems—to help you as they have helped others put the right bearing in the right place—our sales engineers are ready when you are. Hyatt Roller Bearing Company, Newark, Detroit, Chicago, Pittsburgh, Oakland.



# HYATT
## ROLLER BEARINGS
PRODUCT OF GENERAL MOTORS

# NOTEWORTHY PATENTS

TO PRODUCE noiseless typewriter action an idea has been worked out whereby the type bar is brought into printing position at high speed without striking the paper, followed by a secondary movement emulating a pressing action. Raphael Atti invented the device for the L. C. Smith and Corona Typewriters Inc., New York, to which company a patent recently was assigned. The linkage employed to accomplish noiseless operation is shown in *Fig.* 1.

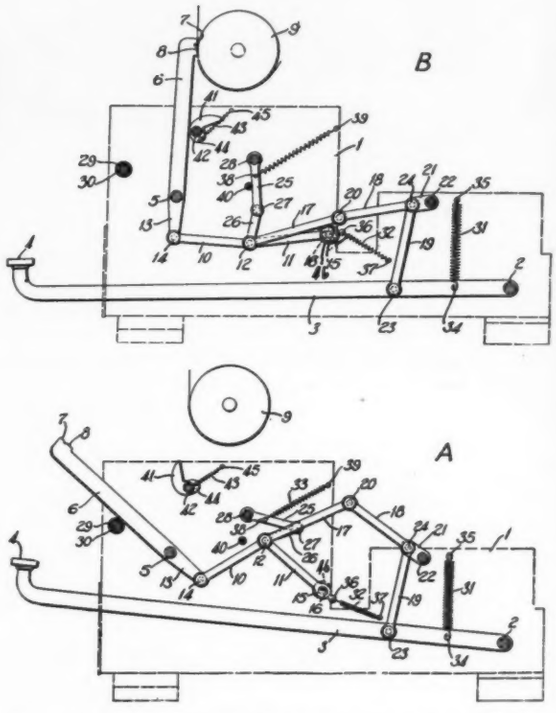



*Fig. 1—Through a system of linkage noiseless action is produced in a typewriter*

Type bar 6 is connected to key bar 3 through a toggle mechanism embracing links 10 and 11. To guide the toggle and maintain it in operative position, or in other words to cause it to break below the center and remain there until it receives the last impetus for printing, links 25 and 26 are provided. Pin 27 pivotally connects them. Springs 31, 32 and 33 are employed to

# FOR YOUR MOTORIZED MACHINES THAT NEED A LIGHT-WEIGHT, HIGH-TORQUE DRIVE WITH GOOD SPEED REGULATION . . . . .

**Use the Type PR compensated-series motors, which are designed to be built into motorized machines. These high-speed "packages of power," light in weight and high in maximum torque, are especially applicable to portable machines that are subject to high momentary overloads.**

## MACHINES LIKE THESE . . .

**DRILLS,** which are subject to severe overload conditions, need the high maximum torque which the Type PR motor can develop. This is particularly true of the 3/4-inch, and larger, drills.

**SAWS,** which must operate with little difference between the load speed and idle speeds, can advantageously use this motor, because it has good speed regulation.

**FLOOR SANDERS** must have a drive with a high maximum torque, because of the heavy momentary overloads caused by uneven floor surfaces. The light weight of the motor adds to the portability of the sander.

**FURNACE BLOWERS** run at high speeds which should vary little with changes in the inlet and outlet settings. Here, again, the high-speed, Type PR motor, with its good speed regulation and light weight, is the right drive.

Our engineers worked hand-in-hand with machine designers to coördinate the motor and its applications. Why not benefit from their background of experience? General Electric, Dept. 6A–201, Schenectady, N. Y.

070-15

**GENERAL ELECTRIC**

urge bar 6 into normal position of rest, *A*, *Fig.* 1.

When key 4 is depressed, link 19 will exert a pull on link 18, thereby thrusting link 17 forward to straighten out the toggle formed between links 10 and 11. Throughout this movement the front end of slot 16 of link 11 is maintained in engagement with pin 15 so that toggle 10-11 will move type bar 6 up to the position where it will not engage platen 9. This position will be held so long as pin 12 is above the line extending from pin 14 to pin 15.

Spring 32 on the other hand will permit link 11 to move further forward and the rear end of slot 16 to engage pin 15 after pin 12 has passed below the line extending from pin 14 to 15. At this point, due to co-operation of links 25 and 26, pin 12 will move forward the required distance to actuate link 10 and type bar 6 and thus bring type 7 into contact with the paper on the platen.

The patent is designated No. 1,952,192.

VIBRATING movement in a device designed for that purpose may be obtained by employing unbalanced weights. A case in point is a vibrator recently patented by Walter L. Keefer

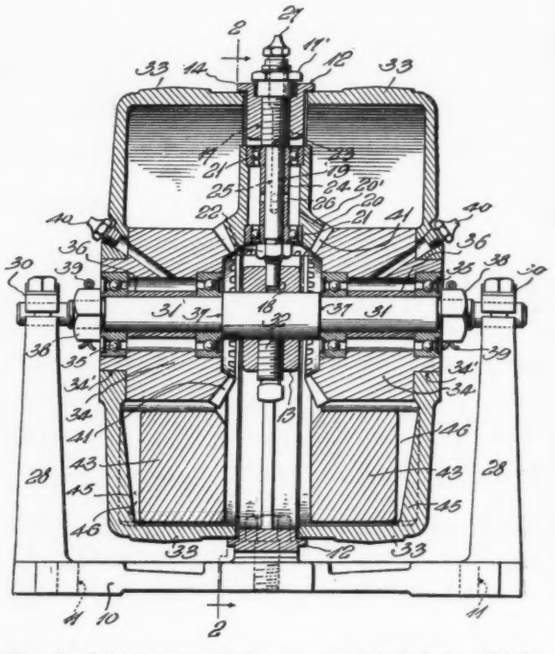
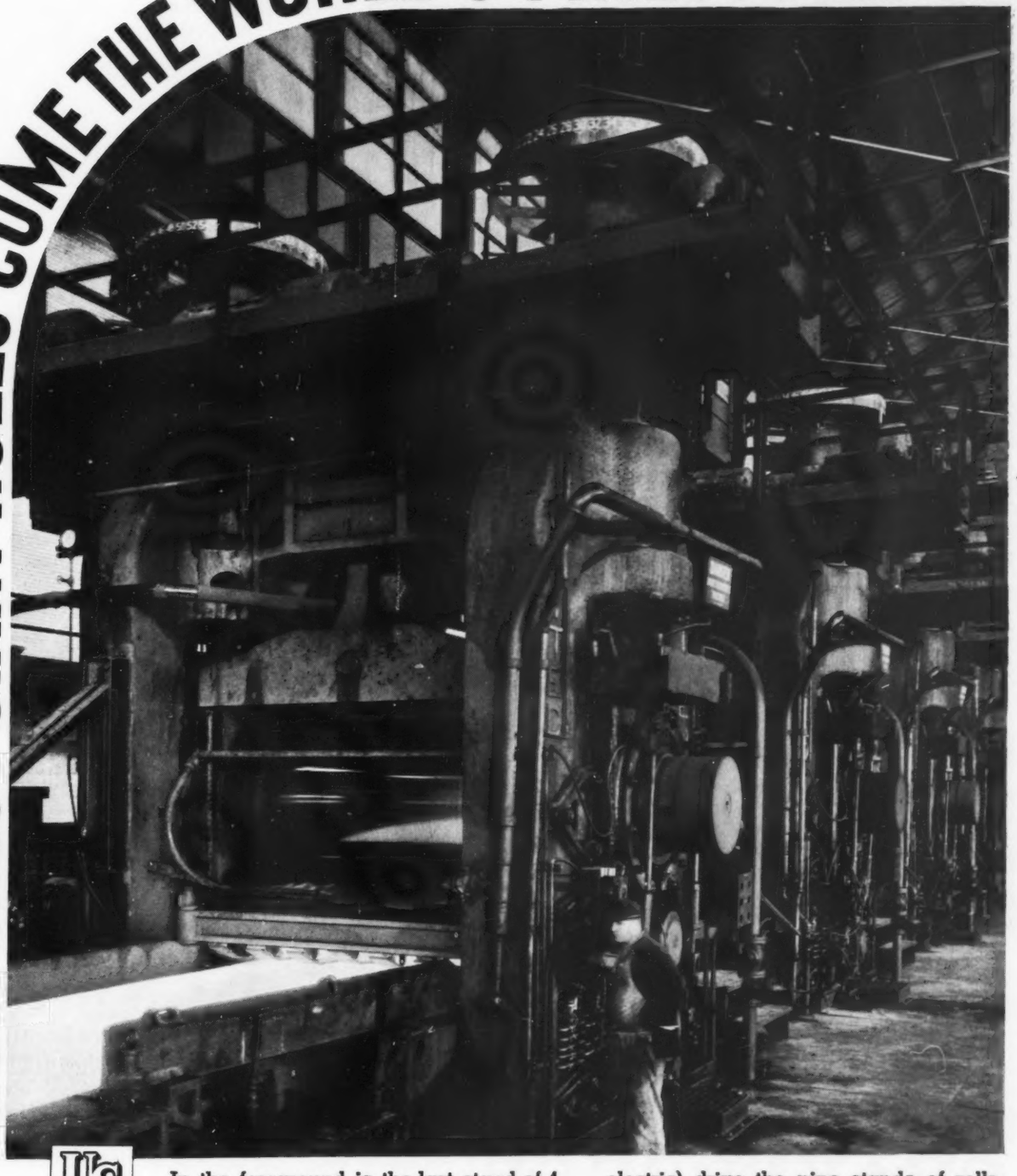


*Fig. 2—Off-center weights are employed to obtain vibrating movement as pulleys rotate*

for the Wolf Co., Chambersburg, Pa. Within cupped pulleys, *Fig.* 2, are two off-center weights 43. Base 10 is bolted to the frame of the machine on which the vibrator is employed. The belt for driving the mechanism may be used on either of the pulleys 33. The driven pulley

# FROM THESE GIANT ROLLS COME THE WORLD'S FINEST PLATES



In the foreground is the last stand of 4-high finishing rolls in Illinois Steel Company's new 96" Continuous Plate Mill.

The entire mill is of the most modern type. 30,000 horsepower (all electric) drive the nine stands of rolls.

The mill has a capacity for plates up to a width of 84 inches, a length of 140 feet, and in thicknesses from one-eighth inch up.

**Illinois Steel Company**

SUBSIDIARY OF UNITED STATES STEEL CORPORATION

208 South La Salle Street, Chicago, Illinois

**ILLINOIS PLATES**

causes its beveled gear 41 to drive the beveled pinion 20, thus rotating through another beveled gear 41 the other pulley in the opposite direction. During rotation of the two pulleys the off-center weights 43 set up such forces as to produce the requisite vibration. The construction provides a device having all necessary rigidity, attention being given particularly to the mainshaft which is mounted in three bearings. One of the features of the design is the elimination of dead weight. Number of the patent is 1,943,220.

BY EMPLOYING vacuum glass vessel handling mechanism, breakage and deformation of the ware is obviated. This is one of the features of a transferring mechanism designed by William L. McNamara for the Capstan Glass Co., Connellsville, Pa. Illustrated in *Fig.* 3,

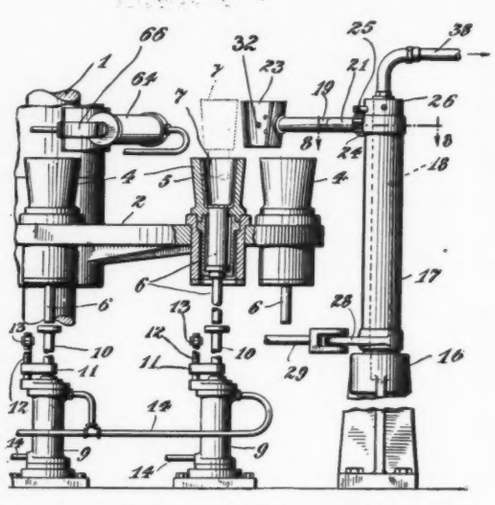
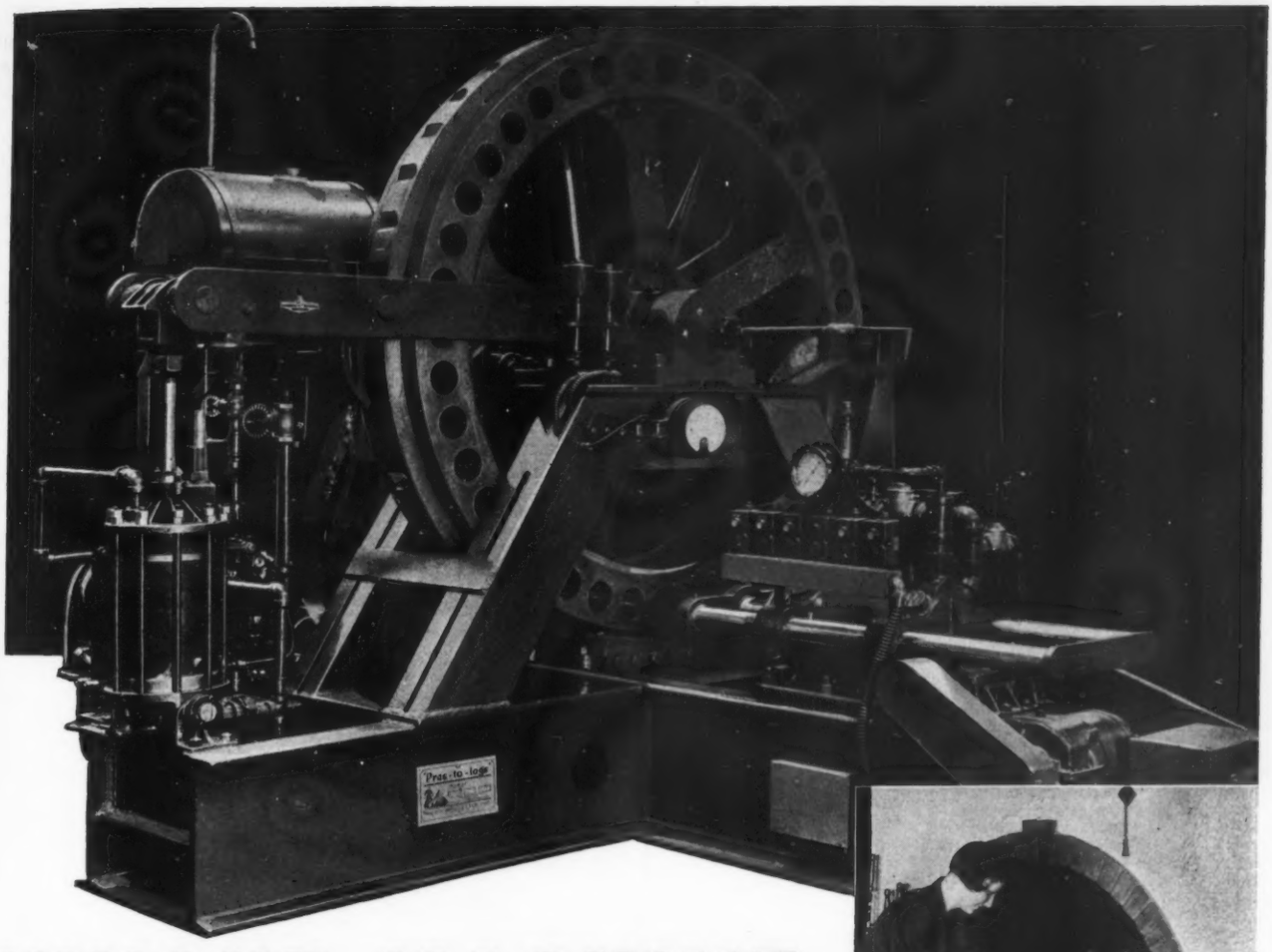



*Fig. 3—Vacuum exercising suction effect through apertures holds glass vessels in jaws*

mold table 2 is operated intermittently and stopped with consecutive molds positioned over pneumatic cylinder 9.

As each mold becomes properly positioned cylinder 9 operates to raise the plungers 6, elevating vessel 7 to the dotted line position. At this time the jaw 23 is oscillated by means of sleeve 17, arm 28 and link 29 to engage the raised vessel. At the time of the engagement vacuum through tube 38 operates to pull the vessel against the surface of the jaw and hold it in that position while the jaw continues to move. It will be observed that the vacuum exercises its suction effect on the walls of the vessel through apertures 32.

After the glass vessel has been carried to a position over an adjacent table the vacuum is rendered ineffective and air is permitted to en-




# UNIQUE MACHINE

## MAKES FUEL LOGS OUT OF SAWDUST

MECHANICAL ingenuity has gained another victory over waste. This unusual-looking machine converts sawdust, wood shavings and other fibrous waste materials into conveniently-handled fuel by compressing them into logs at the rate of 10 tons of logs every 24 hours.

No binder is used, compression alone being employed to do the work.

Naturally extremely high pressures are developed in the process. These include a maximum pressure of 200,000 pounds at the screw auger and compression head, 20,000 pounds per square inch on the material at the end of the screw auger extension head, 30,000-40,000 pounds at the die disc and 25,000 pounds at the pressure regulating cylinder.

Under such operating conditions the bearing problem was a difficult one, but it has been completely solved by the use of heavy duty Timken Bearings throughout the machine, resulting in minimum power consumption; dependability; low maintenance cost; and extended life. The machine is manufactured and leased by Wood Briquettes, Inc., Lewiston, Idaho, and Willamette-Ersted Company, Portland, Oregon.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

**TIMKEN** *Tapered Roller* **BEARINGS**

ter to release the vessel. As soon as the vessel clears jaw 23, the jaw is free to move backward to position for engaging another vessel.

The patent is identified as No. 1,947,609.

INCREASE in the popularity of coin-operated machines draws attention to a patent recently granted Arthur W. Barnard for a coin intercepting mechanism. Colonial Scale, Boston, is assignee. Number of the patent is 1,937,500. The device is designed for application on coin-operated machines to permit the person depositing the coin, by a certain amount of skill, to secure its return.

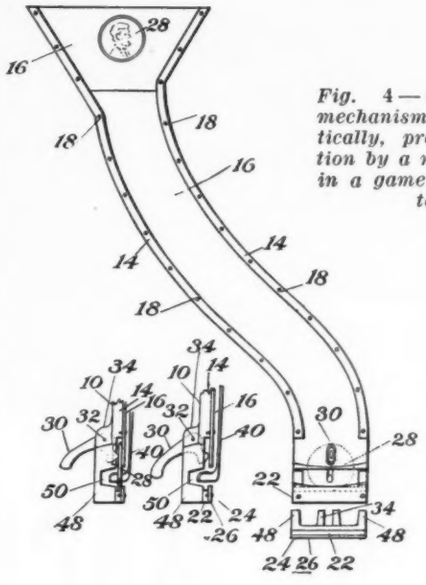



*Fig. 4 — Coin intercepting mechanism holds token vertically, preparatory to ejection by a miniature golf club in a game for testing operator's skill*

Referring to *Fig.* 4, the drawings show one form of interceptive mechanism embodying a chute, the lower end of which is designed to stop and retain coin 28 and to hold it in ejecting position. The lower end is formed to maintain the coin on edge by means of a flange 22. In order to hold the coin against lateral rolling or bouncing when it strikes the chute bottom on its downward travel, there is provided a detent or pawl 30 pivotally mounted on a pin 32.

For accomplishing the lateral ejection of the coin any striking member may be provided such as one comprising an arm or lever 40 to represent a golf club as employed in the familiar coin-operated golf games. The swinging member (a duplicate of the club) is mounted adjacent the chute 10 so that when it is swung the striking end of the member will sweep the lower end of the chute, hitting the coin and ejecting it. Whether the coin will take the proper course to be returned to the operator depends, of course, on the skill exercised in manipulating the miniature golf club.

# LATEST DIEHL F. H. P. MOTORS

*add new sales appeal*

Diehl Open Type Repulsion start, Induction Motor, 1/4 HP., 1725 RPM.

Diehl Open Type Split Phase Motor, 1/6 HP., 1140 RPM., 60-cycle.

ATTAIN new high standards of performance and appearance—powerful selling features—in your machines by equipping them with latest Diehl fractional horsepower motors.

Their outstanding features include minimized servicing, practically silent operation, attractive appearance, bettered electrical characteristics, prolonged life and other refinements.

The very latest improvements in small motor design are incorporated, and standard ratings range from 1/40 to 3/4 H.P. All single phase types, including split-phase, capacitor, repulsion, repulsion-induction, series and shaded pole are available, also polyphase, and direct current types.

Mechanical or electrical modifications of these motors to afford certain advantages for special applications can be provided quickly and economically by Diehl's unsurpassed production facilities.

DIEHL

FOR EVERY INDUSTRY

**FRACTIONAL HP. MOTORS**

Split Phase — Repulsion-Induction — Condenser Type — Shaded Pole — Direct Current

**INTEGRAL HP. MOTORS**

Squirrel Cage — Repulsion-Induction — Condenser Type — Slip Ring — Direct Current

**VENTILATING FANS**

Large: 18" to 48" — Small: 9" to 16"

Avail yourself of Diehl's half century of motor building experience by consulting our sales engineers when your next motor problem arises.

Write to Diehl Manufacturing Company, Elizabethport, New Jersey, or to District Offices in Atlanta, Boston, Chicago, New York and Philadelphia.

DIEHL MANUFACTURING COMPANY

*Electrical Division of*

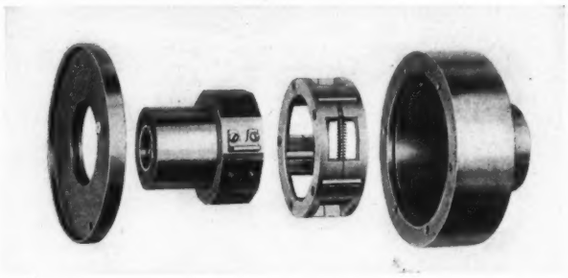
THE SINGER MANUFACTURING COMPANY

# DIEHL MOTORS

722

# New Materials and Parts

DESIGNED to insure instant engagement and release, the overrunning clutch introduced by Hilliard Corp., Elmira, N. Y., is based on the principle that a roller running between an outer ring and an inner flat surface will drive between the outer and inner members when rotation is in one direction, and release or run free when rotation is reversed or when one member runs ahead of the other. Parts of the clutch, shown herewith, are made of wear-resisting materials properly treated. The rollers are held in a bronze cage which is retained in its proper position when assembled by the small bracket shown on one face of the hub. Rollers bear on every other flat surface and the bearing point is at one side of the center of the flat. The rollers also engage the ring pressed into the outer sleeve.



*Overrunning clutch is especially designed to satisfy requirements of industrial applications*

In continual operation, any wear that occurs takes place on the flat surfaces. These surfaces may be renewed four times without the necessity of new parts simply by moving the cage carrying the rollers to new positions on the center hub. A felt seal prevents any leakage of lubricant.

---

## Side-Contact Roller Chain Employed

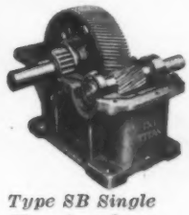
SELF-ADJUSTING, positive variable speed transmissions for fractional horsepower drives have been announced by Link-Belt Co., Chicago. The V. R. D. (Variable Roller Drive), shown herewith, is capable of an output of one-half horsepower at maximum speed, with a maximum ratio of speed variation of 10 to 1. Features of P. I. V. companion drive such as compact, all-metal construction; total enclosure; self-lubrication in an oilbath; protection from moisture and grit; and the use of a chain

*Type MDVZ and MTVZ Vertical Type Double and Triple Reduction Powered Gears.*

*Type HGM Single Reduction Powered Gear.*

*Types MDZ and MTZ Double and Triple Reduction Powered Gears.*

*Type 8-120 ADM Double Reduction Mash Tub Drive.*



*Type SB Single Herring bone Reducer Type SX Single Helical Reducer.*

*IXL Spur Gear Speed Reducer.*

*Type HGV Hygrade Vertical Worm Gear Speed Reducer.*

# SPEED REDUCERS— POWERED GEARS— OR JUST GEARS?

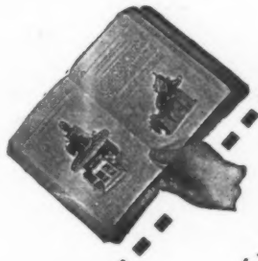
Which should it be? There is only one correct answer. Your speed reduction problem can be solved quickly by Foote Bros. engineers—men who have solved literally thousands of widely different problems involving speed reduction. Foote Bros. engineers have available a complete line of *all types* of speed reducing devices—for every conceivable application. There is a Foote Bros. sales engineer near you who will be glad to help you select exactly the right type for your job. Save your own time by using his knowledge. Phone him—or mail the coupon for a copy of "Gear Problems."

**Foote Bros.**
**GEAR AND MACHINE CO.**
5303 SO. WESTERN BLVD. CHICAGO, ILL.

*Type HGS Hygrade Worm Reducer.*

*Type W—Commercial Worm Gear Reducer.*

***Here's the answer— for plant executives and engineers—***



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- Speed Reducers
- Powered Gears
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- Gears of all kinds
- Special Machinery

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5303 S. Western Blvd., Chicago, Ill.
Without obligation, please mail me a free copy of your new 600-pagebook "Gear Problems."

Name.....
Company.....
Address.....

for transmitting the power positively are continued in the new units.

The chain used for transmitting the power from the input to the output shaft is a side-contact roller chain, consisting of steel links, made endless and connected by hardened steel pins in hardened steel joint bushings. Openings in each pitch of links provide a pocket for each of two hard steel rollers, and from both sides a portion of roller protrudes sufficiently to permit each pair of chain rollers, at each engagement of chain and wheels, to roll into contact with the hardened steel conical opposed disks forming the driver and driven wheels, until finally the chain is engaged positively in the wedge-shaped wheels at the proper pitch line for the speed desired on the output shaft. The disengagement of the chain also is a rolling action.

*Self-adjusting variable speed transmission is totally enclosed and protected from moisture and grit*

## Announces High Tensile Electrode

DESIGNED especially for use on high tensile steels, the new Shield-Arc Eighty-Five electrode introduced by Lincoln Electric Co., Cleveland, provides welds with tensile strength of 85,000 to 100,000 pounds and ductility from 15 to 20 per cent elongation in two inches. The electrode is suitable for flat, vertical and overhead welding, and is available in 5/32 and 3/16-inch sizes. It is heavily coated, and is particularly suitable for the welding of those low alloy steels which, on normalizing, have tensile strengths under 100,000.

## Breaker Protects Small Motors

FOR the protection of fractional horsepower motors, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. has brought out a new Type H sentinal breaker. Available in single and double pole types, this breaker, shown herewith, protects against burnouts which might be caused by low voltage, locked rotor or overload conditions when driving appliances such as washing machines, small woodworking tools, fans, blowers, etc.

This breaker, when properly applied, permits

# *Get The Facts—*

ABOUT THE *NEW*

# ALEMITE HYDRAULIC LUBRICATION SYSTEM

*. . . the greatest advance in lubrication since the original* ALEMITE SYSTEM!

**Find out how you can Standardize on this modern method of lubrication without changing design! *Adds an outstanding new sales feature at little or no increase in cost!* Consult Alemite Engineers without obligation!**

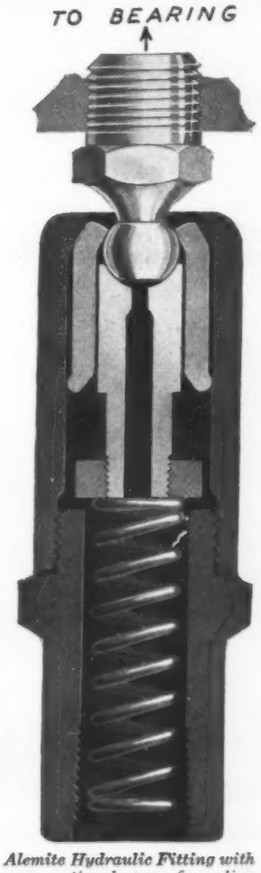
THIS new Alemite Hydraulic Lubrication System is far more than a mere improvement on a previous method of lubrication. It embodies principles so new and practical that engineers will recognize its advantages at first sight!

With it, *positive lubrication of all bearing points can be assured!* It can be included in present specifications without making other changes or alterations in design. Machinery now made up and lubricated by oil holes, grease cups, or by previous Alemite systems, can be easily and quickly modernized by changing over to the new Alemite Hydraulic Fittings.

It is an interesting fact that 99% of the 1934 motor cars have adopted the Alemite Hydraulic Lubrication System as standard equipment. This was done only after exhaustive testing in a field where proper lubrication is all-important. The same advantages that recommended it to automotive engineers make it attractive for difficult industrial applications.

Its ability to reduce maintenance costs will make it an outstanding sales feature on any product for which it is specified!

**DESIGNERS WILL WANT FULL ENGINEERING INFORMATION ON THIS RADICALLY *NEW* SYSTEM OF LUBRICATION—*USE COUPON!***




*Alemite Hydraulic Fitting with cross-sectional view of coupling*

### *The Basic Principle of Alemite's New Hydraulic Lubrication System!*

This new system embodies a new principle of applying lubricant through new fittings. It cuts time, labor and lubricant required to service bearings and assures positive lubrication under any and all conditions.

A coupling of entirely new design is used in combination with a new-style fitting or nipple to effect the most perfect seal which has ever been possible. This coupling actually grips the fitting so quickly that contact between gun and any fitting is established instantly.

The coupling STAYS LOCKED on the fitting—cannot slip off—so long as pressure is being applied. As pressure is increased, the grip of the coupling increases —"the greater the pressure, the tighter the seal."

With this system, it is easily possible to build pressures up to 10,000 pounds per square inch by hand!

Like former Alemite systems, the new Alemite Hydraulic comprises fittings of all necessary angles and sizes, and adapters for both power and hand operated equipment.

**ALEMITE CORPORATION, Division of Stewart-Warner Corp'n.**
**1890 DIVERSEY PARKWAY CHICAGO, ILLINOIS**

ALEMITE CORPORATION M.D.-5
Division of Stewart-Warner Corporation
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Please forward complete engineering information on the New Alemite Hydraulic Lubrication System.

*Name*.....

*Company*.....

*Address*.....

*City*..... *State*.....

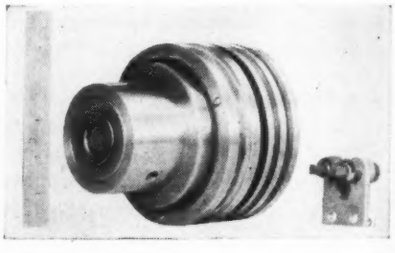
sufficient time delay to start successfully small motors, the starting current of which is high in ratio to the full load current. It also permits such a motor to carry momentary overload without disconnecting it from the line. However, it


*Momentary overloads may be carried without damage by motors equipped with improved breakers*

will disconnect a motor from the line when locked, even when its locked rotor current is relatively low in comparison to its full load current.

## Small Clutch Acts as Brake

A NEW combination clutch-brake unit only five inches in diameter has been developed by Magnetic Mfg. Co., Milwaukee, Wis. The manufacturer gives this clutch brake combination, shown herewith, torque rating in the brake of 40 inch pounds and in the clutch of 80 inch pounds. It can be arranged for maximum bore

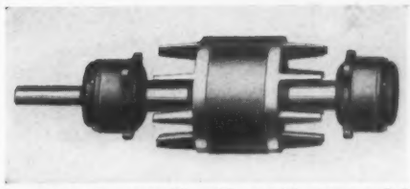


*Clutch-brake unit is of the mechanically safety type insuring positive stopping*

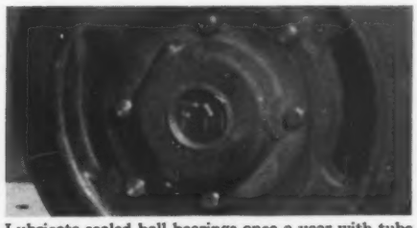
of ⅞ inches and it can be operated from any source of direct current up to and including 250 volts. The brake is of the mechanical safety type, spring actuated, thus assuring positive stopping in the event of any interruption in the electric circuit. Similar clutch-brake combinations of both smaller and larger diameter are available.

## Electrode Operates in All Positions

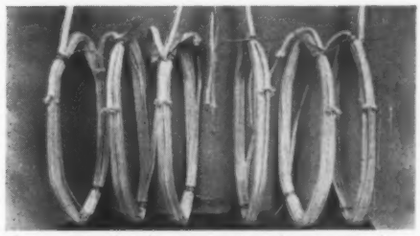
A GENERAL purpose welding electrode, designated as type W-22, has been added to the line of arc welding electrodes manufactured by General Electric Co., Schenectady, N. Y. The new electrode is of the heavily coated type, and

Complete rotor assembly with cartridge-type sealed ball bearings. Note rotor winding is of one-piece construction.



Lubricate sealed ball bearings once a year with tube contained lubricant. Bearings, dust tight. No lubrication drip.



Group wound coils—an entire phase group in a single piece of wire—lead connections from each group *welded*, not soldered or brazed.

Sealed-in leads through frame opening—anchored permanently. No chance for strain on field leads.

Slot insulation — self locking by means of cuff construction — permanent and additional protection for field windings.

Final vibrometer test—one of a series to insure a smooth running motor with minimum vibration.

● Fairbanks-Morse pioneered many of the standards of the present day motor. To these, are now added new features which still make F-M Motors the greatest value you can offer your customers.

Today the pioneering still goes on—pioneering to create the standards of the industry of tomorrow. But F-M pioneering is an *exacting* pioneering! It is a developed method of building motors better *mechanically*—building them better to serve longer at lower maintenance expense—and hence to help you sell.

These motors meet the most exacting electrical specifications. But with characteristic thoroughness, Fairbanks-Morse has achieved a position of leadership in *mechanical* construction.

Fairbanks-Morse pioneered *mechanical excellence* in electric motors. It pioneered *ball bearings, grease tube lubrication, one-piece rotor construction.*

Pioneers in motor building progress, Fairbanks-Morse asks only an investigation of how much *more* these motors have to offer. Start your investigation by writing for full information. Address Fairbanks, Morse & Co., 900 S. Wabash Avenue, Chicago, Ill. 32 Branches at your service throughout the United States.

*Pioneer Designers and Manufacturers of POWER, PUMPING AND WEIGHING EQUIPMENT 104 Years*

# FAIRBANKS-MORSE
## MOTORS

6086 EA 40-63

produces welds of the quality required for Class I pressure vessels according to the A.S.M.E. boiler construction code. Its distinctive feature is that it may be used in any position, i.e., for flat, vertical or overhead welding, and at the same time has deep penetrating properties. It is therefore equally suitable for butt and fillet welds.

## Bearing Shield Retains Lubricant

STANDARD S.A.E. No. 203 shielded bearings have been added to the line of radial bearings being manufactured by Bantam Ball Bearing Co., South Bend, Ind. The shield of this new bearing, shown herewith, retains the lubricant in the bearing and at the same time prevents dust or dirt from entering the bearings. This feature is of advantage in applications where a considerable amount of abrasive matter is present. Another advantage is lessoning of the possibility of materials being damaged by oil from the bearing.

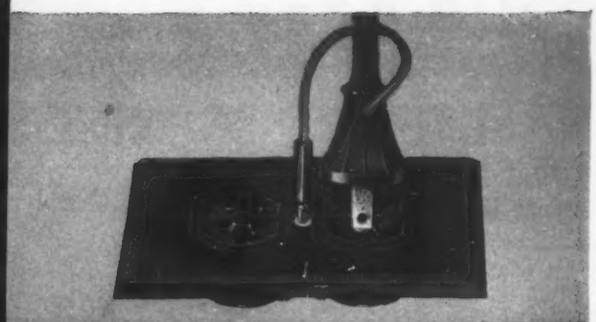
*Shield on recently introduced bearing retains the lubricant and prevents dust and dirt from entering the bearing*

Another recent development of the company in large heavy duty bearings is a bearing which is a combination of straight rollers and taper rollers. By variation of the various elements, a bearing of this type can be produced that will carry desirable combinations of radial and thrust loads.

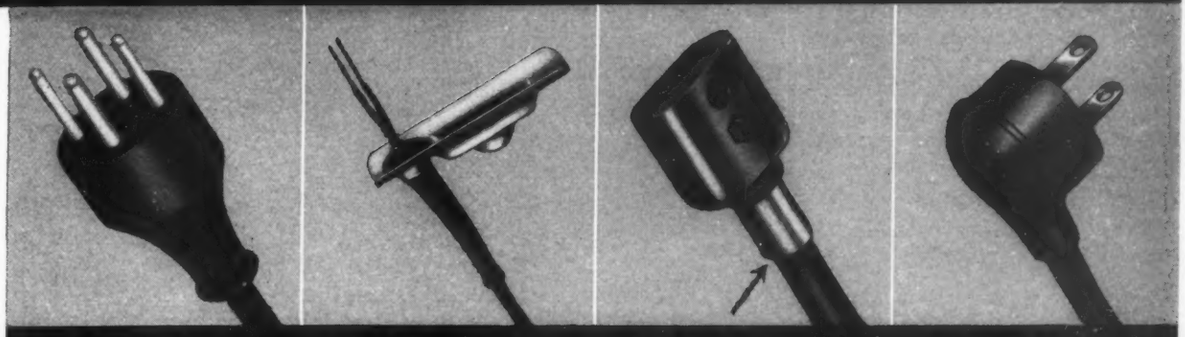
## Bearing Stock Is Semifinished

BEARING bronze stock semifinished on both the outside and the inside is now being offered by Magnolia Metal Co., Elizabeth, N. J. In the manufacture of this stock, which includes the innovation of semifinshing on the inside, the dimensions are maintained a full one-sixteenth inch extra on both surfaces for the final finishing. Ends are also prepared so that the full length of bar can be used. The stock is furnished in standard 12, 13 and 14-inch lengths,

# ONE-PIECE CONSTRUCTION MAKES G-E MOULDED RUBBER DEVICES OUTSTANDING



Standard rubber plug with ground connection moulded onto the cord.

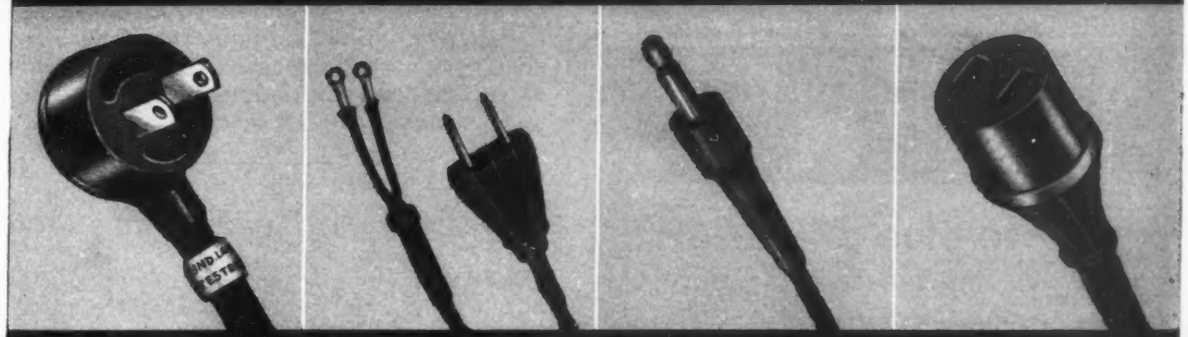


Special radio four-contact rubber cap moulded onto the cord.

Special vacuum cleaner cord with moulded rubber strain relief.

Moulded rubber strain relief for Catalog No. 13X157 Connector.

Special rubber angle plug for vacuum cleaner motor connection.



Rubber angle plug moulded onto the cord for refrigerator service.

Special rubber strain relief, flat rubber cap, both moulded on cord.

Special jack plug, for plug-board assembly — moulded onto the cord.

Small rubber connector for GE-2711 receptacle. Both moulded on cord.

**All G-E Moulded Rubber Devices are moulded onto the cord in one piece — not simply attached. They will outlive their cords. They are built to last.**

**Investigate G-E Moulded Rubber Devices. Notice, from the accompanying illustrations, how adaptable they are. Compare them with any others designed for similar needs. You will decide on these superior G-E Moulded Rubber Devices.**

**A representative will gladly call and discuss G-E Moulded Rubber Devices with you. Write now to Section Q-453, Merchandise Department, General Electric Company, Bridgeport, Connecticut.**

# GENERAL ELECTRIC

## ACCESSORY EQUIPMENT

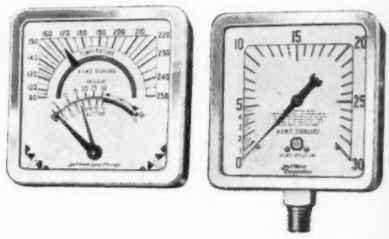
MERCHANDISE DEPARTMENT. GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

from one-half inch solid up to 5 inches outside diameter, cored up to 2½ inches inside diameter.

---

## Gages Are of Modern Design

MOUNTED in a modern design of square case, a new line of gages available in a wide variety of pressure applications has been brought out by Jas. P. Marsh Corp., 2073 Southport avenue, Chicago. These instruments, shown herewith, are made in one size—3½ inch dial. They can be supplied with dial reading in pressure, vacuum, feet of water or in practically any type of pressure reading desired. They are also available in standard low pressure steam graduations, as well as in a combination instrument in which the temperature, pressure and feet of water are shown on the same dial. The instruments can be supplied with lower connection for mounting directly in the top of the apparatus, with rear connection for application to the side or the front, or for flush mounting inside of the jacket. A wide variety of finishes are available.



*Square case design in new line of gages harmonizes with the appearance of modern machines*

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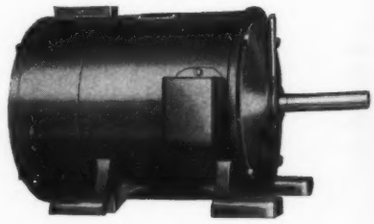
## Designs Air Conditioning Motors

DIRECT current motors developed especially to meet the requirements of air conditioning equipment on railway cars have been brought out by Century Electric Co., St. Louis. The frame of the motor, shown herewith, is cast or rolled steel construction with welded steel feet. End brackets are of cast steel. Bearings are grease lubricated ball bearings. Frame and end brackets are solid except for those holes used for commutator and brush inspection.



*Differing current conditions are accommodated by motor developed for air conditioning railway cars*

The electrical characteristics are designed to meet the requirements when the current supply

varies in voltage due to the change of speed of the generating unit driven from the trucks of the railway car and for storage battery operation when the car is not in motion.

## Introduces Improved Transmissions

VARIABLE speed devices in upright design have been added to the line of Vari-speed motors manufactured by Sterling Electric Motors Inc., Los Angeles. The new unit, shown herewith, is totally enclosed and is available in ratings up to 15 horsepower. Standard varia-


*Infinitely variable speeds are obtainable from drive unit developed into a totally enclosed vertical model*

tions, adjustable by infinite degrees, are 2:1—3:1—4:1. The upright design operates on the same principle as the units previously introduced. A high speed V-belt runs on two V-pulleys the diameters of which can be adjusted infinitely to give different ratios between the diameters of the driving and driven pulleys.

## Controls Welding Current

A REMOTE control device for arc welding machines has been added to the line of welding equipment manufactured by Lincoln Electric Co., Cleveland. With this device, known as Lincolntrol, no additional cables or other apparatus need be carried by the operator, as it does not involve the use of additional cables, rheostat or additional apparatus of any kind. The mechanism is encased in a small box which is attached to the welder voltage control. Regular hand controls may still be used if desired.

In controlling the machine from a remote point, the operator taps the electrode on the work several times and the voltage is raised automatically. A larger number of taps and the voltage is lowered. Thus by tapping the electrode—making and breaking the electrical circuit—the current output of the generator is controlled.

# Are Piece Rates Feasible in Design Work

(*Concluded from Page* 33)

advancement is assured since his accomplishments are on record.

The institution of a piece rate system will eliminate the necessity of using the reference system in hiring men. The applicant will state his qualifications, and be assigned to a board. There will be no discussion of his ability or salary requirements. He will be handed a job on which the price is set. It is then up to him to perform. That first assignment will show conclusively whether or not he comes up to the standard of the department.

### Standards Are Improved

The general standard of the drawing room will be improved, since the shirker will have earning capacity proportionate to his efforts, while the worker will increase his earnings by increased efficiency.

Increased efficiency results in reduced personnel which in turn means better supervision. Better supervision results in better work, lowered percentage of errors, smaller junk piles, and generally reduced engineering cost per job.

Properly installed, piece rate systems for engineering departments are entirely practical. Engineering costs can be reduced fifty per cent, and if the employer is satisfied with 25 per cent and allows his men the other 25 per cent the system will be successful. But if the employer insists on taking all the profit and uses the scheme simply for the benefit of his own pocketbook, the result will be a flat failure.

Articles on this and allied subjects published in previous issues of MACHINE DESIGN include:

"Organization and Supervision of Design Department," by John F. Hardecker, Sept., 1929, p. 22, Oct., 1929, p. 27, Nov., 1929, p. 26, Dec., 1929, p. 33, Jan., 1930, p. 36, Feb., 1930, p. 39.

"Is the Bonus System Possible?" by John F. Hardecker, April, 1930, p. 45, also by John Flodin, June, 1930, p. 49.

"Effecting Economies in Work of Engineering Departments," by John F. Hardecker, July, 1930, p. 31.

"Preserving Valuable Drawings," by E. L. Chevraux, Sept., 1930, p. 49, Oct., 1930, p. 32, Dec., 1930, p. 48.

"Overcoming Filing Difficulties," by W. S. Brown, March, 1931, p. 50.

"Tabulation of Drawings," by Fred L. Burns, April, 1931, p. 58.

"Improving Drafting Management by Squad Organization," by F. D. Newbury, May, 1931, p. 46.

"Work Graphs Visualize Personnel Activities," by L. F. Remington, May, 1931, p. 49.

"Qualifications Required in Selection of Design Engineers," Aug., 1931, p. 55.

"Scheduling Design Procedure," by M. W. Elmendorf, Oct., 1932, p. 49.

"Eliminating Drawing Confusion," by W. S. Brown, Dec., 1932, p. 45, Jan., 1933, p. 39.

"Employ a Piece Rate System?" Sept., 1933, p. 37; also by Harry Kaufman and Carl Morey, Oct., 1933, p. 37; R. E. W. Harrison and William C. Williard, Nov., 1933, p. 37, and by J. M. Murphy, Dec., 1933, p. 37.

"Organizing Design Procedure," by H. W. Hoover, Dec., 1933, p. 27.

"Cut Waste—Use Modern Numbering Plan!" by M. W. Elmendorf, March, 1934, p. 15.


ALLOYS (STEEL)—A most complete table of physical properties of many commonly used spring materials including stainless steel for springs, cold rolled spring steel, hot rolled spring steel, cold drawn wire produced by both the soft and hard processes and nonferrous materials is included in the March, 1934, issue of *The Mainspring* published by Wallace Barnes Co., Bristol, Conn.

ALLOYS (STEEL)—High manganese steels are the subject of a bulletin of Union Drawn Steel Co., Massillon, O. The bulletin describes the steels, gives possible applications, and outlines production advantages.

CAST PARTS—Steps in the production of Sivyer steel are presented pictorially and described in the 25th anniversary edition of *Ladle Sparks* published by Sivyer Steel Casting Co., Milwaukee.

CLUTCHES—Overrunning clutches of new design are presented in bulletin No. 103 of Hilliard Corp., Elmira. N. Y. The bulletin describes the unit, gives its principle of operation, and includes complete data on the dimensions and capacities of various sizes.

COMPOSITION MATERIALS—Micabond, a bonded mica insulating material is described in a new booklet of Continental-Diamond Fibre Co., Newark, Del. The booklet gives the various forms in which the material is available, presents typical uses and includes physical properties.

COUPLINGS—Falk Corp., Milwaukee, is distributing a new bulletin describing the Falk-Rawson 4-duty coupling. The bulletin includes a description, cross sectional views, application information and engineering data.

DESIGN DEPARTMENT—A complete line of equipment for the design department including plan files of both oak and steel, drawing tables of many types, reference tables, drawing boards and similar equipment are presented in a new booklet of Hamilton Mfg. Co., Two Rivers, Wis.

DRIVES—Link-Belt Co., Chicago, is distributing its new general catalog which covers elevating and conveying chains, elevator buckets, sprocket wheels, chain drives, power transmission machinery, positive variable speed transmission units, standardized bucket elevators, apron conveyors, screw conveyors, belt conveyors, bucket elevators and conveyors, flight conveyors, and machinery of many types.

FINISHES—Parker Rust-Proof Co., Detroit, has prepared a bulletin on a common cause of paint failure and its scientific prevention. The field covered includes all of the different types of enamels and lacquers, except

vitreous enamel, in all of their various applications to iron and steel products, especially as they may be applied to sheet metal.

FINISHES—Chapmanizing, a new process for hardening low carbon steel, is completely presented in a comprehensive booklet of Chapman Valve Mfg. Co., Indian Orchard, Mass. The process is founded on the fact that iron base alloys will absorb certain hardening elements when heated either above or below the critical temperatures of the alloys. The booklet includes illustrations and descriptions of applications of the process.

HEATING UNITS—Harold E. Trent Co., Philadelphia, has prepared a bulletin on its line of electric heating elements and units. The bulletin gives sizes, capacities and characteristics of the units.

MOTORS—Holtzer-Cabot Electric Co., Boston, has prepared two bulletins on motors for heating and ventilating centrifugal fans and propeller fans. The bulletins describe the possible applications completely, give characteristics of the motors, and include engineering data and dimensions.

MOTORS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued an illustrated leaflet on its line of quiet operating motors. The bulletin describes the method of individual testing of these motors for quietness, their distinctive features, construction, application and control.

REGULATORS—Taylor Instrument Cos., Rochester, N. Y., has published a booklet on its line of Fulscope recording regulators for control of temperatures, pressures, rate of flow or liquid levels. The bulletin describes the regulators and gives their working principle.

SHAPES—Cold drawn squares and flats are described in a recent bulletin of Union Drawn Steel Co., Massillon, O., which gives standard size ranges, compositions, manufacturing tolerances and applications.

THERMOMETERS—Brown Instrument Co., Philadelphia, has published a new 32-page catalog featuring resistance thermometers for measuring temperature from minus 300 to plus 1000 degrees Fahr. The instruments are available in indicating, recording and controlling types.

VALVES—New designs of air valves which have no metal-to-metal wear and are so constructed that the greater the air pressure the tighter the seal, are described in a recent publication issued by C. B. Hunt & Son, Salem, O.

WELDED PARTS AND EQUIPMENT—Tobin bronze and other Anaconda copper alloys used as welding rods are completely presented in a recent booklet of American Brass Co., Waterbury, Conn. The booklet gives detailed information on the welding properties, melting points, weight and strength data, method of procedure and individual characteristics of each of the rods.

WHEELS—Blower wheels for oil burners, stokers, air conditioning units and similar applications are described in bulletin No. 399 of B. F. Sturtevant Co., Boston, Mass. The bulletin gives possible applications of the wheels and standard sizes available.

## Research Publications

*Impact Testing of Cast Iron.* This extensive report on the usefulness of the several forms of impact test as applied to cast iron contains one of the most comprehensive series of data ever assembled on the physical properties of this material. Some 500 test bars were specially cast, machined and tested by the several methods investigated, on the various types of machines commercially in use. Extensive tables give the results on the transverse, tension, fatigue, compression and shear test which were made and by the use of charts and illustrations these data are condensed in convenient form. The conclusions of the committee in charge and the comments by interested authorities are included. Published by American Society for Testing Materials, 260 Broad street, Philadelphia. 51 pp. 50 cents.

*Special Slide Rules,* by J. N. Arnold. The special slide rule is one of three related methods for performing routine computations. These are: intersection charts, alignment charts and special slide rules. The advantages of these methods include: Less likelihood of error; mental effort on the part of the person who must solve the problem is reduced to a minimum; the time required for solving the problem is usually less; and occasionally greater accuracy can be obtained by one of these methods than by the ordinary method of solution. This booklet covers examples of special slide rules; theory of the rules; and construction of the rules. There is included in the appendix a short bibliography on slide rules, a description of some of the commercial special slide rules, and a logarithmic chart that is useful in constructing scales for special rules. Published as extension series bulletin No. 32 by Engineering Extension department, Purdue University, Lafayette, Ind. 40 pp.

*Economic Lot Sizes in Manufacturing,* by Paul T. Norton, Jr. Economic lot size problems may be solved in several different ways, and a number of formulas have been developed for this purpose. The authors of some of these formulas have attempted to include every variable which has any effect on the general problem, with the result that such formulas are very complicated. While these complicated formulas can be simplified for practical use, no one should attempt such a simplification unless he understands the derivation of the complete formula. This would seem to limit their usefulness to those companies that are large enough to employ an expert in this particular field. The formula developed in this bulletin is simple enough to be understood and used by anyone, while it includes all of the factors necessary for a correct solution of the problem. Published as engineering extension division series bulletin No. 31 by Virginia Polytechnic Institute, Blacksburg, Va. 31 pp.

# Index To Advertisers



*Advertisements appear in previous issues.

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*MACHINE DESIGN* is a monthly technical publication conceived, edited and directed expressly for those executives and engineers responsible for the creation and improvement of machines built for sale, and for the selection of the materials and parts to be used.

# Business Announcements and Sales Briefs

F B. OLCOTT, for the past ten years senior materials engineer, bureau of construction and repair, navy department, has resigned to become associated with Col. A. P. Shirley in a newly organized firm of Shirley & Olcott, 220 Mills building, Washington, handling Washington sales representation for the Alan Wood Steel Co., Latrobe Electric Steel Co., Michigan Steel Castings Co., and Bridgeport Brass Co.

* * *

David Adams has been appointed Pittsburgh district sales manager of Falk Corp., Milwaukee, succeeding W. O. Beyer who resigned recently. Mr. Adams has been with the Falk company for the past four years in the sales department at Milwaukee and previously had been with National Malleable & Steel Castings Co. and W. A. Riddell Co. His office will be in the Grant building.

* * *

Timken Roller Bearing Co., Canton, O., has moved its Pittsburgh district sales office to 414-416 North Craig street. John L. Young is district manager of the Pittsburgh office.

* * *

E. C. Gainsborg, sales manager, Roller Bearing Co. of America, Trenton, N. J., has resigned, effective immediately.

* * *

Robert MacMinn has been appointed manager of the Chicago district, in charge of operations and sales for McClintic-Marshall Corp., Bethlehem, Pa., succeeding E. J. Paulus who has been elected vice president of the company in charge of operations.

* * *

A. J. Howell has been appointed manager of the Pacific Coast district of Revere Copper & Brass Inc. to succeed R. R. Binns Jr., who has moved to the executive offices in New York as assistant general sales manager. Mr. Howell will make his office in the Russ building, San Francisco.

* * *

Robins Conveying Belt Co., New York, has appointed new sales agencies as follows: Fred Bathke, 1957 University Place, St. Paul, who will represent the company in the state of Minnesota, the western part of Wisconsin and the northwestern corner of Michigan; and Raymond Church, Box 114, Pleasant Ridge Station, Cincinnati, whose territory will include the southwestern part of Ohio, the southeastern section of Indiana, and the western part of Kentucky.

* * *

Joseph C. Eckel has been appointed assistant general manager of sales at Pittsburgh for American Sheet & Tin Plate Co.

* * *

Republic Steel Corp., Youngstown, O., has appointed Gate City Iron Works Co., Omaha, Nebr., and Earle M. Jorgerson, Los Angeles, distributors for Enduro stainless steel.

* * *

Mitchell Specialty Co., Holmesburg, Philadelphia, is now engaged in the manufacture of a general line of metal moldings and shapes, either in straight length or bent form and in a variety of cross sections. A. R. Evans, formerly with Edward G. Budd Mfg. Co., is in charge of sales.

# *Completely Sealed*

## *and lubricated for long, carefree and efficient service* BY FAFNIR


*You will find interesting facts about modern machines in every issue of Fafnir's house organ, "The Dragon." We will gladly add your name to the mailing list.*

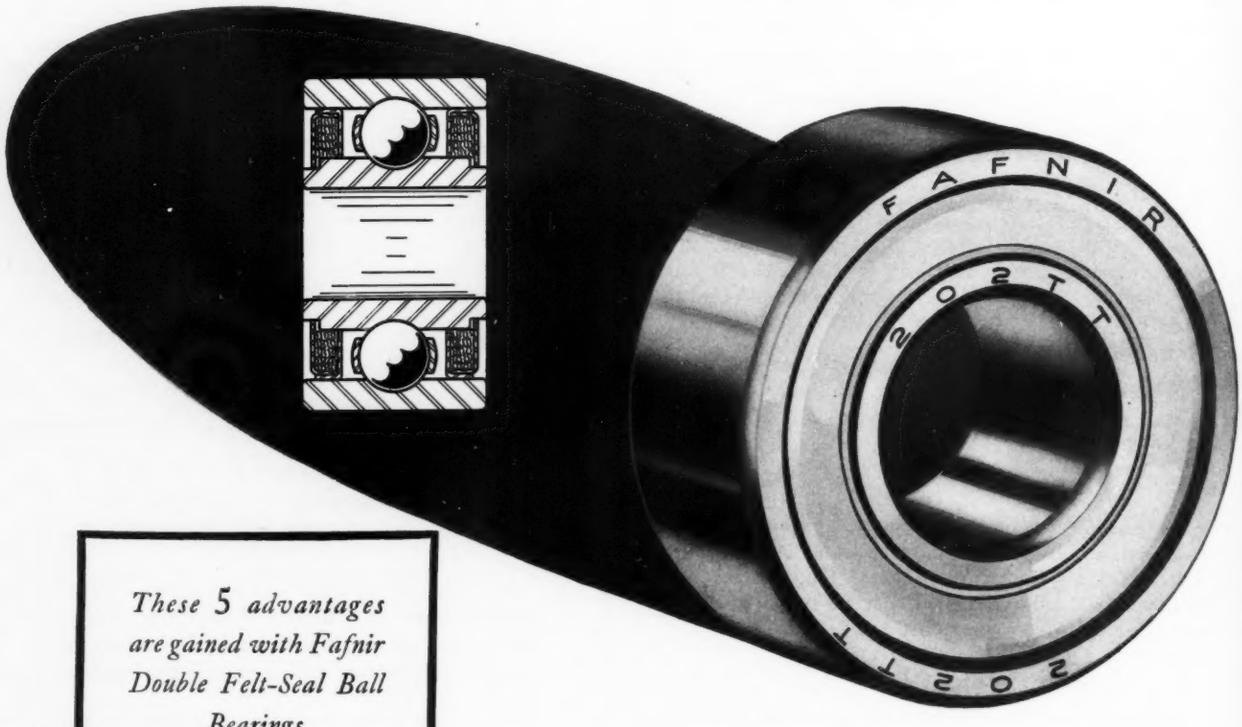
Thoroughly tested and proven in service! That is your assurance when using Fafnir Double Felt-Seal Ball Bearings. Lubricants have no chance of leaking. Dust, dirt and fumes cannot enter. The seal is positive protection.

Machine designers and builders are finding this Fafnir Ball Bearing the most satisfactory means of providing an adequate closure for standard ball bearing mountings. Where lubrication is difficult or impossible, Fafnir Felt-Seal Ball Bearings provide the economical solution. Moreover, these bearings also simplify design, machining and assembly.

Thousands of machines have been simplified and improved by Fafnir Felt-Seals. Let us survey the possibilities on your machines. Our engineering staff is at your service.

• • •

THE FAFNIR BEARING COMPANY, *New Britain, Conn.*
Atlanta . . Chicago . . Cleveland . . Dallas . . Detroit . . Milwaukee . . Minneapolis . . New York . . Philadelphia.




*These 5 advantages are gained with Fafnir Double Felt-Seal Ball Bearings*

1. Relubrication is minimized, sometimes never needed at all
2. Machining costs are reduced
3. Greater compactness is obtained
4. Assembly is faster, disassembly easier
5. A more effective seal is assured

# FAFNIR
## BALL BEARINGS